amplipex

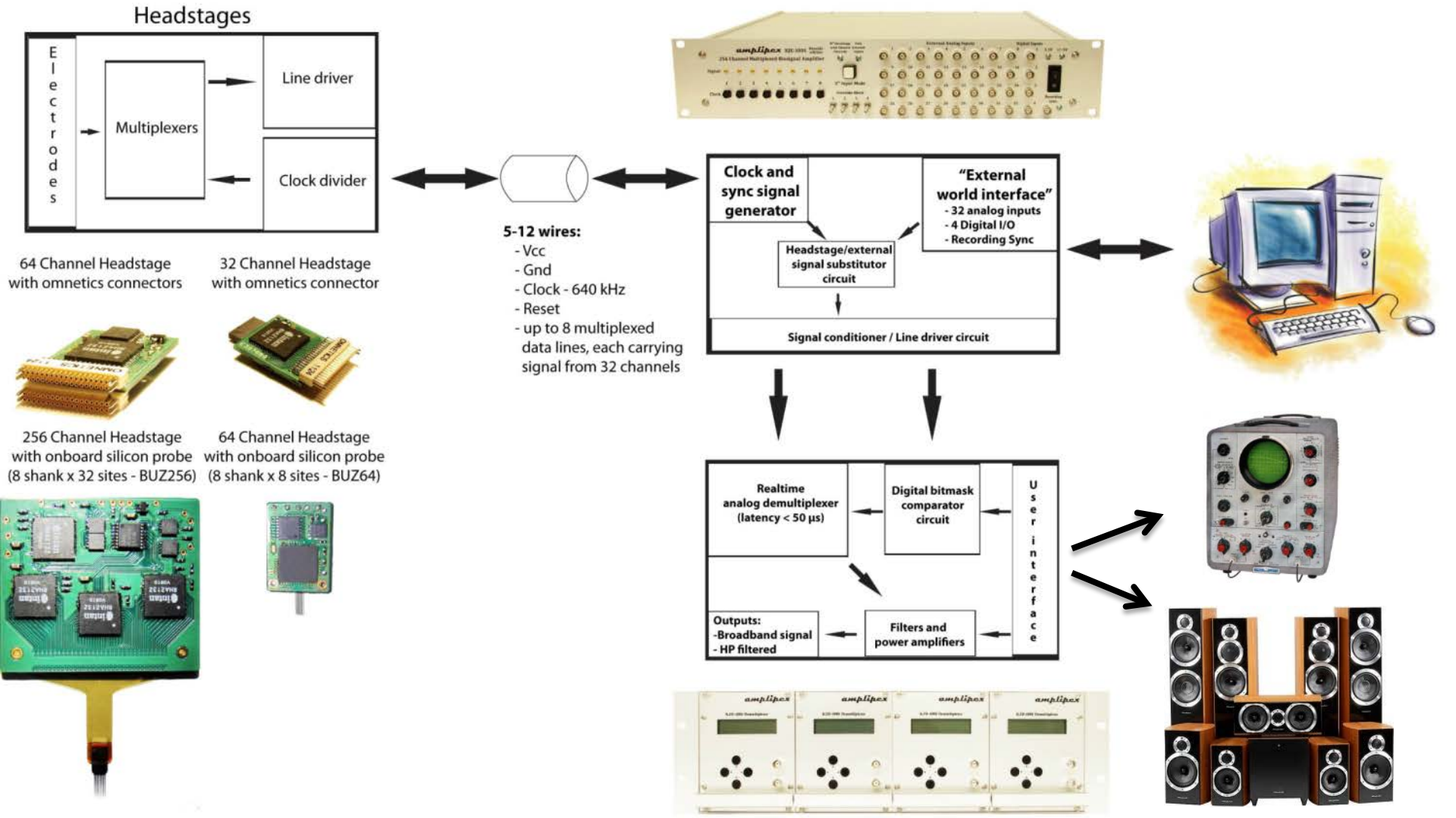
KJE-1001 recording system

Updated:2012.12.14

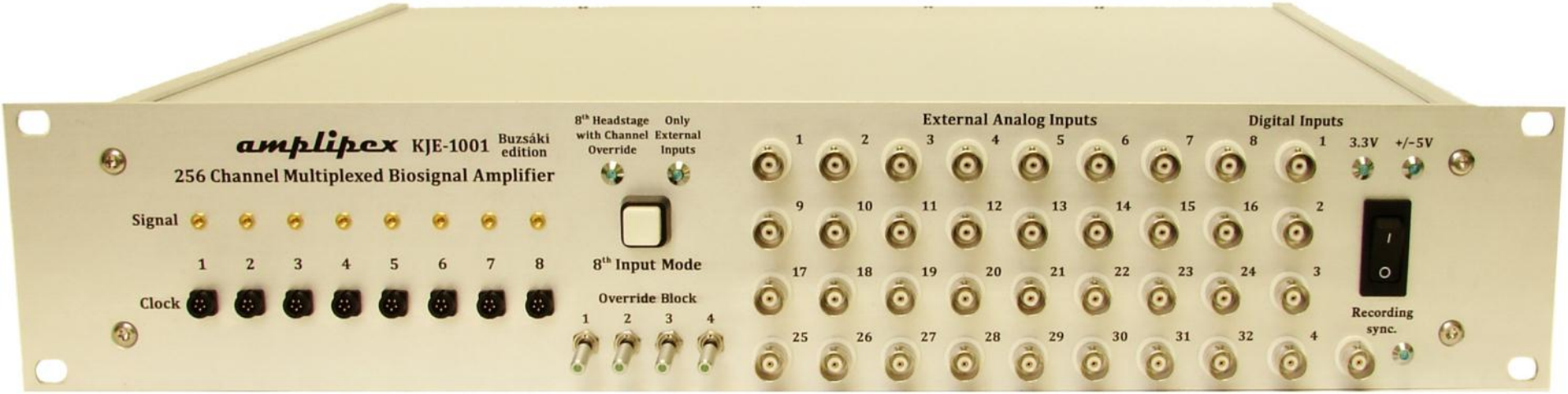
- Mainbox (KJE-1001)
- Demultiplexer (KJD-1000)
- Grass audio monitor
- Oscilloscope
- PC + Monitor

+ a USB webcam

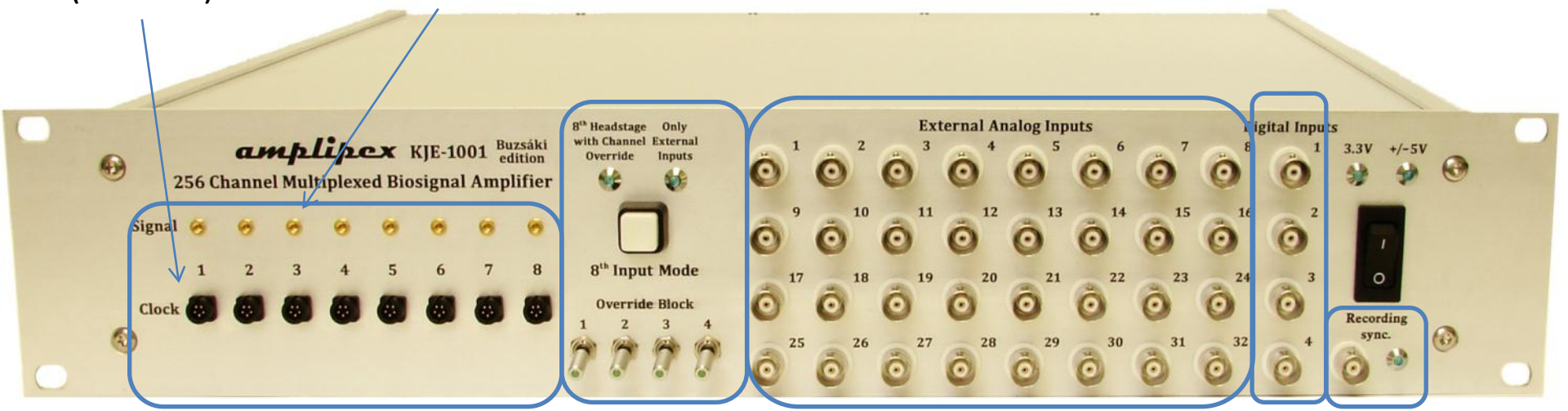
General system overview



Mainbox


amplipex KJE-1001 Buzsáki edition
256 Channel Multiplexed Biosignal Amplifier
Signal
Clock
1 2 3 4 5 6 7 8
8th Headstage with Channel Override
Only External Inputs
8th Input Mode
Override Block
1 2 3 4
External Analog Inputs
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16
17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32
Digital Inputs
1 2 3 4
3.3V
+/-5V
Recording sync.

Mainbox


Clock, reset, power for headstages (all identical)
Multiplexed signal inputs
amplipex KJE-1001 Buzsáki edition
256 Channel Multiplexed Biosignal Amplifier
Signal
Clock
1 2 3 4 5 6 7 8
8th Headstage with Channel Override
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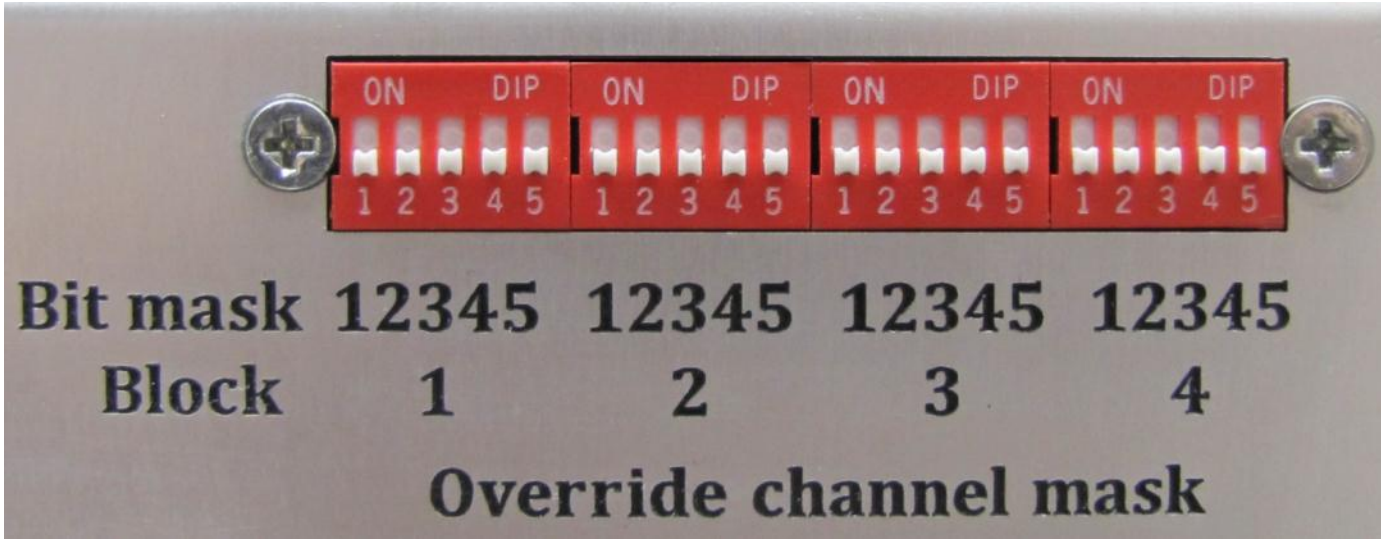
9 10 11 12 13 14 15 16
17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32
Digital Inputs
1 2 3 4
3.3V
+/-5V
Recording sync.
Headstage inputs
8th input channel mode selector
External analog inputs
Digital inputs
Recording sync signal output

Mainbox


Alternative headstage input
Channel override mode channel selector
~110-220V AC 50/60Hz
Made in Szeged, Hungary
Amplipex Ltd.
Model: KJE-1001
SN:
DOM:
Caution: Not for medical use
Chassis / AC Ground
Headstage / DC
To DEMUX units
Headstage I/O
To DAQ card
Bit mask 12345 12345 12345 12345
Block 1 2 3 4
Override channel mask
To demultiplexer box
To computer

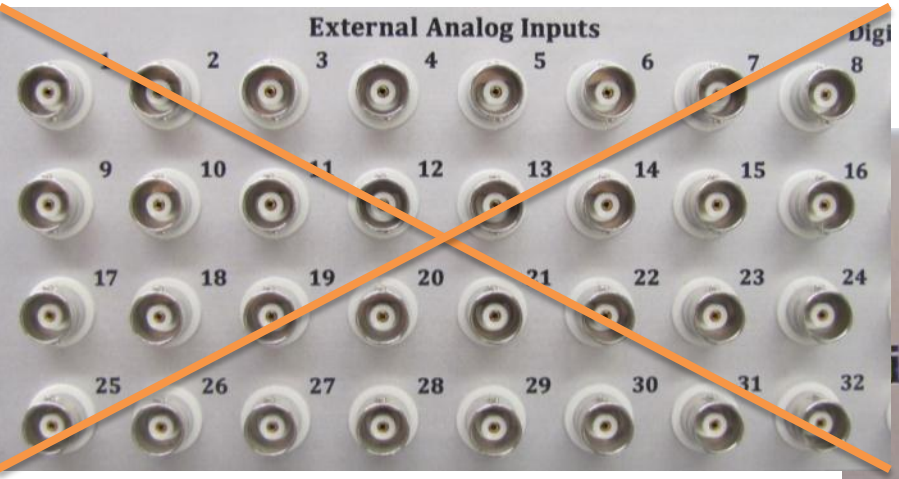
How to use input 8
(the last 32 channels)

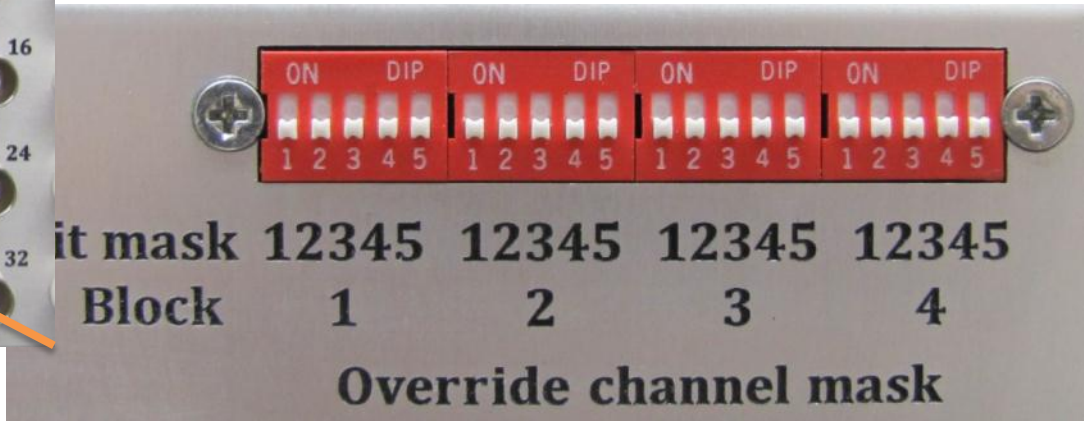


Examples

To have the 8th headstage input working (e.g. when using 256 ch headstage):

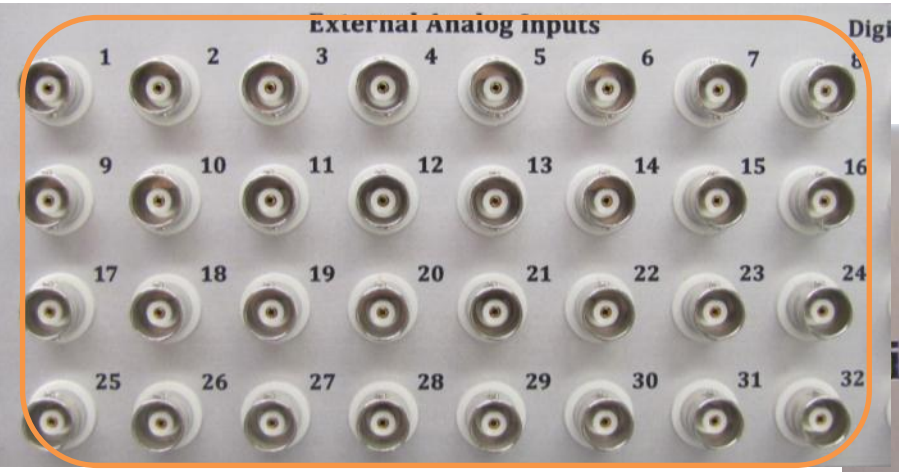
- Set 8th input mode to „8th Headstage with channel Override”
- Switch off all Override blocks

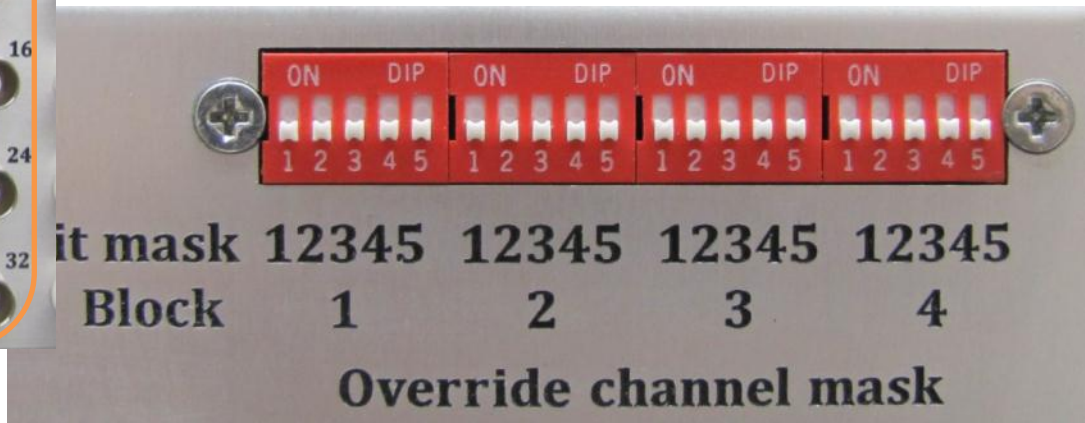




Examples

- To have all 32 external inputs working (e.g. when using only a few headstages and need many external inputs) :
  - Set 8th input mode to „Only external inputs”

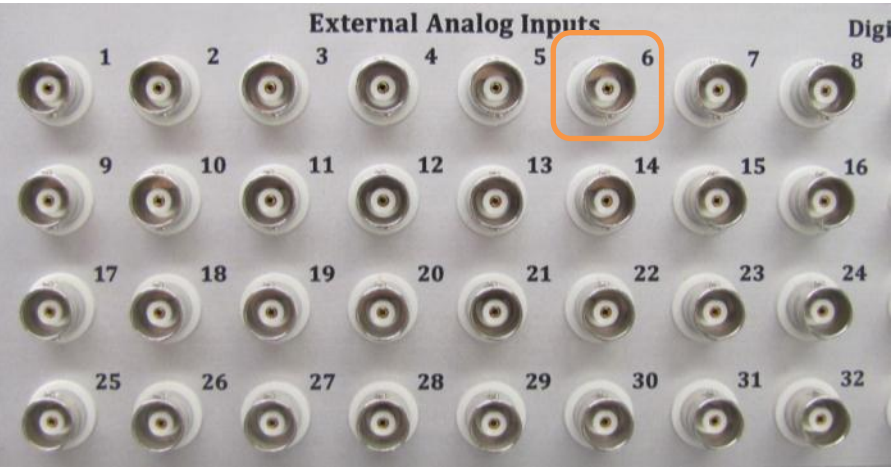


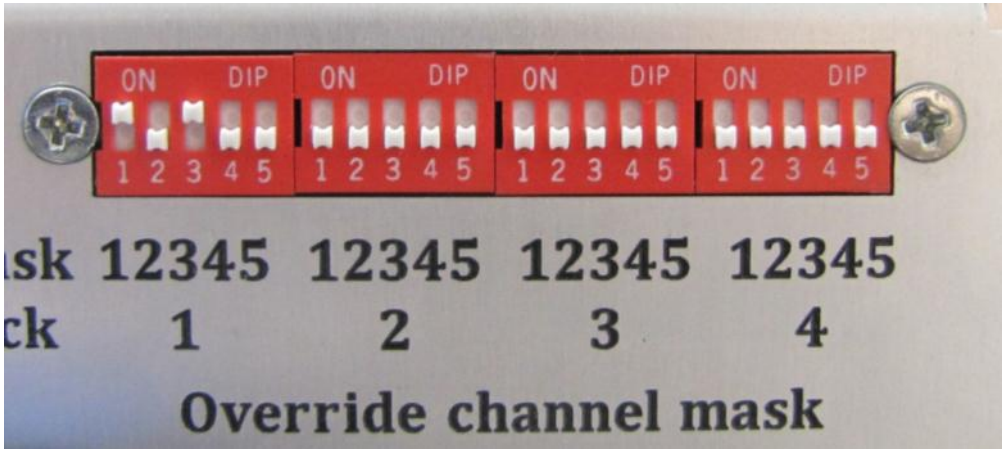


Examples

To have the **6th** External input working and all the other 31 from the 8th headstage input:

- Set 10100 **(5)** on block 1, and set switch 1 on.

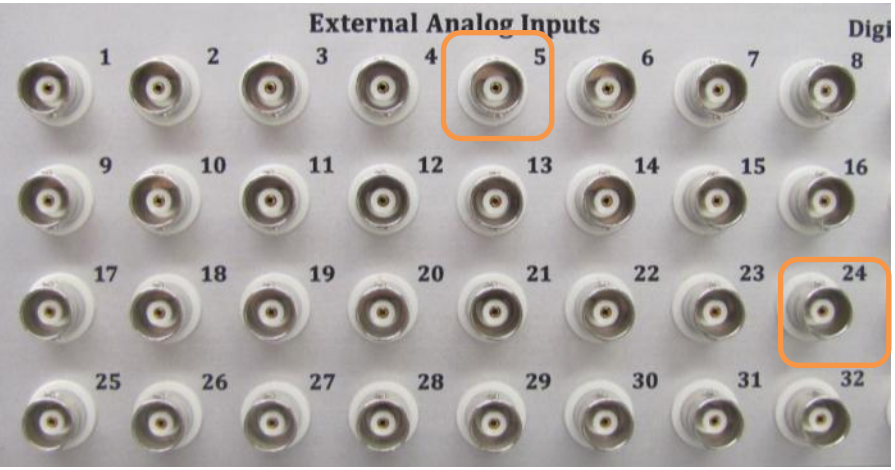


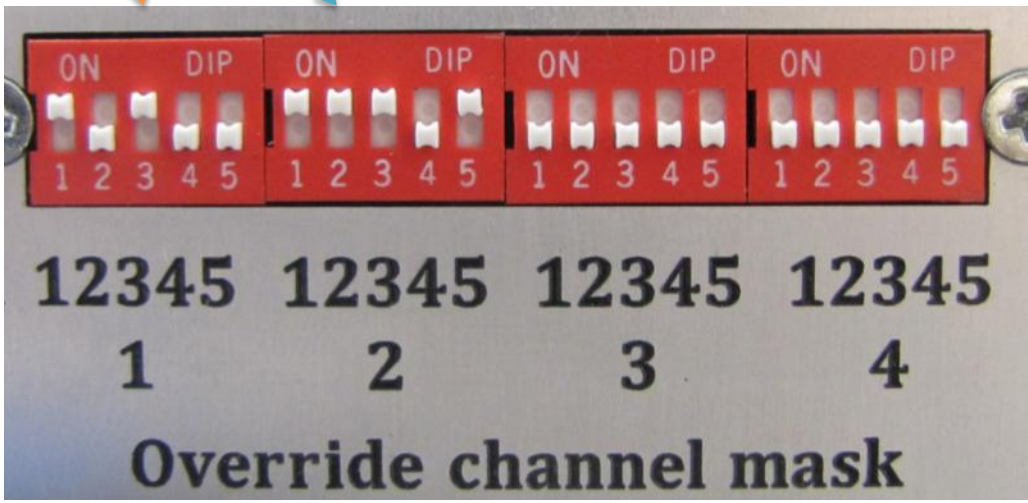


Examples

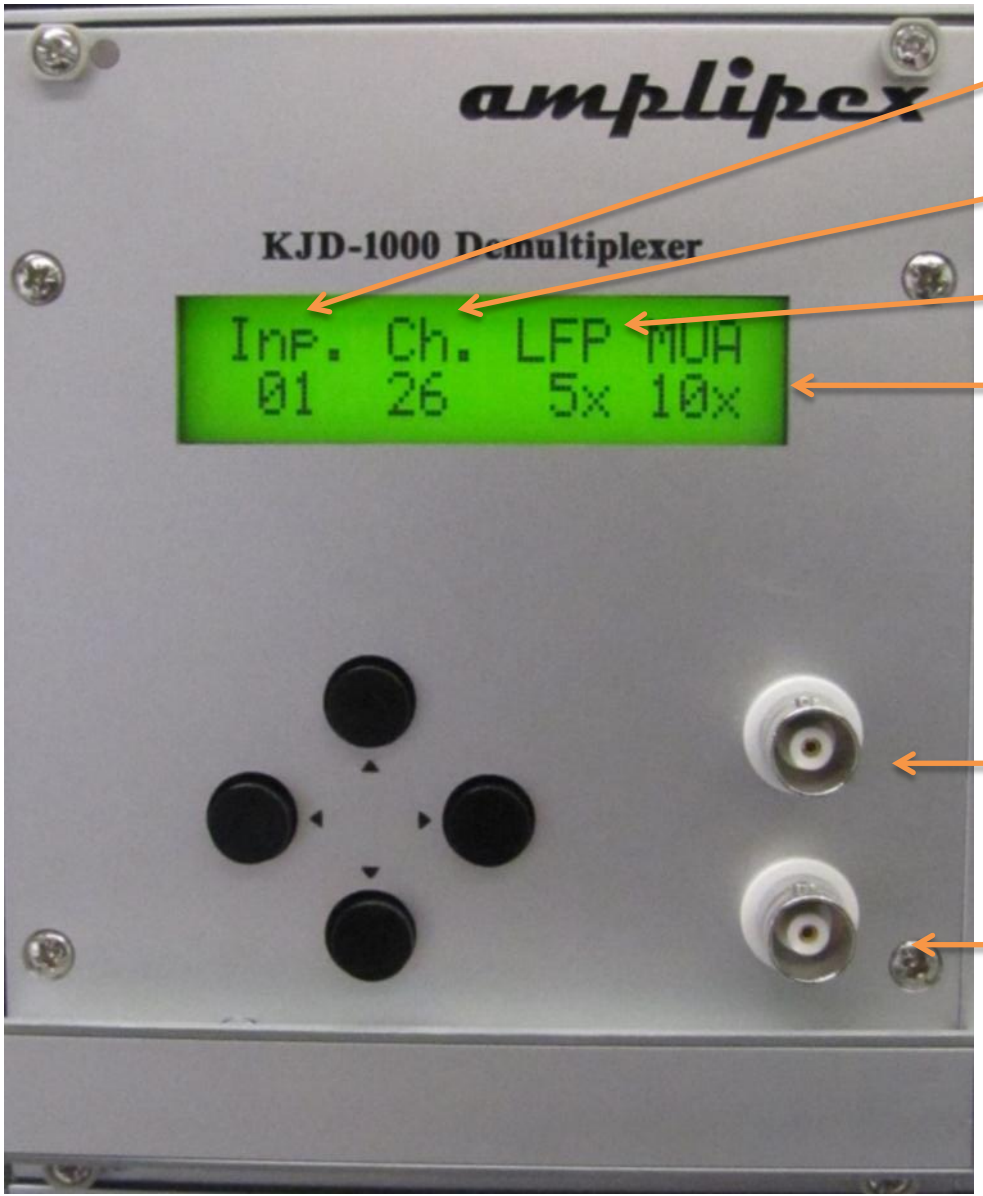
To have the **6th** and **24th** External input working and all the other 30 from the 8th headstage input:

- Set 10100 **(5)** on block 1, and set switch 1 on.
- Set 11101 **(23)** on block 2, and set switch 2 on.

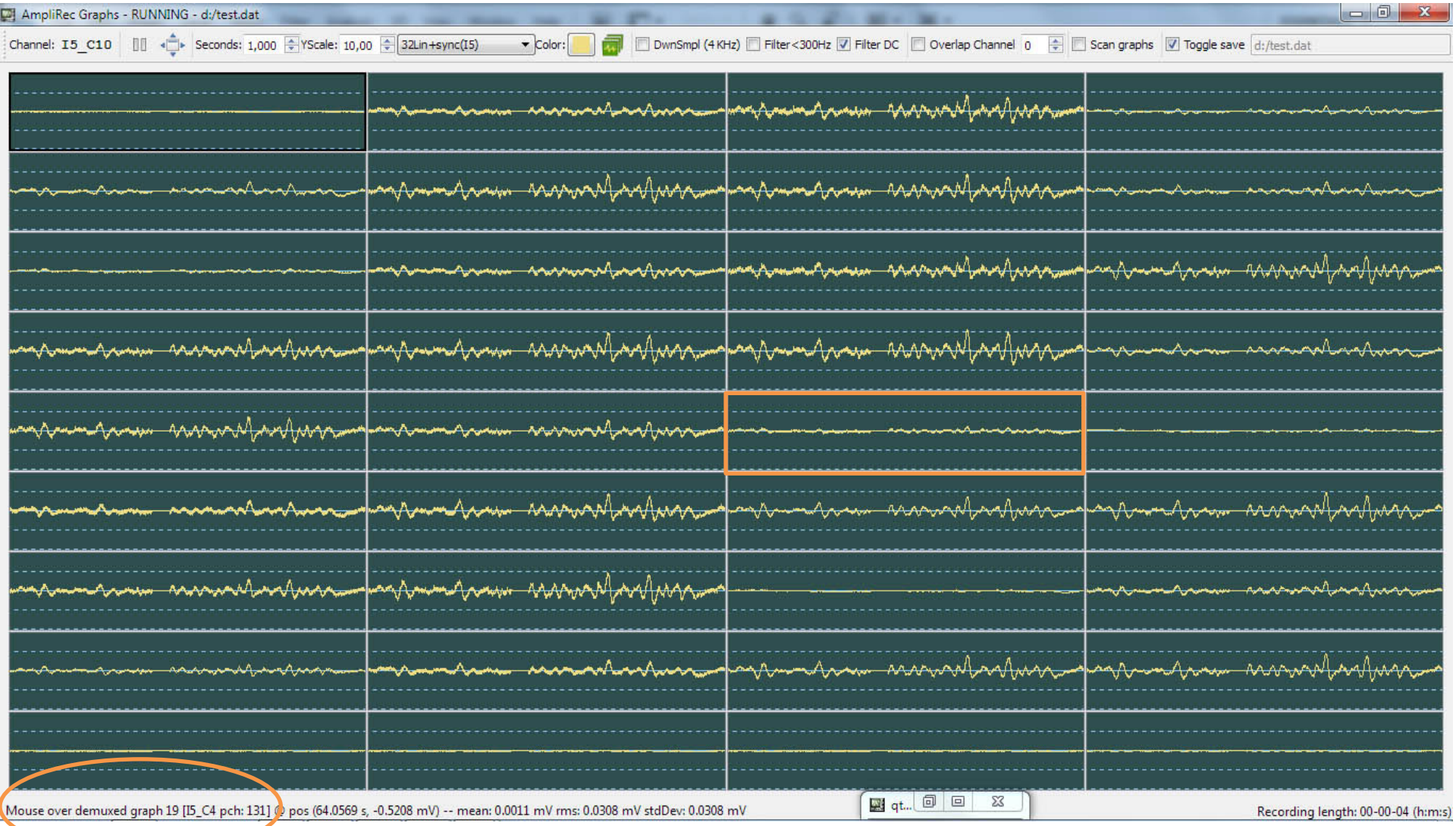




KJD-1000 Demultiplexer

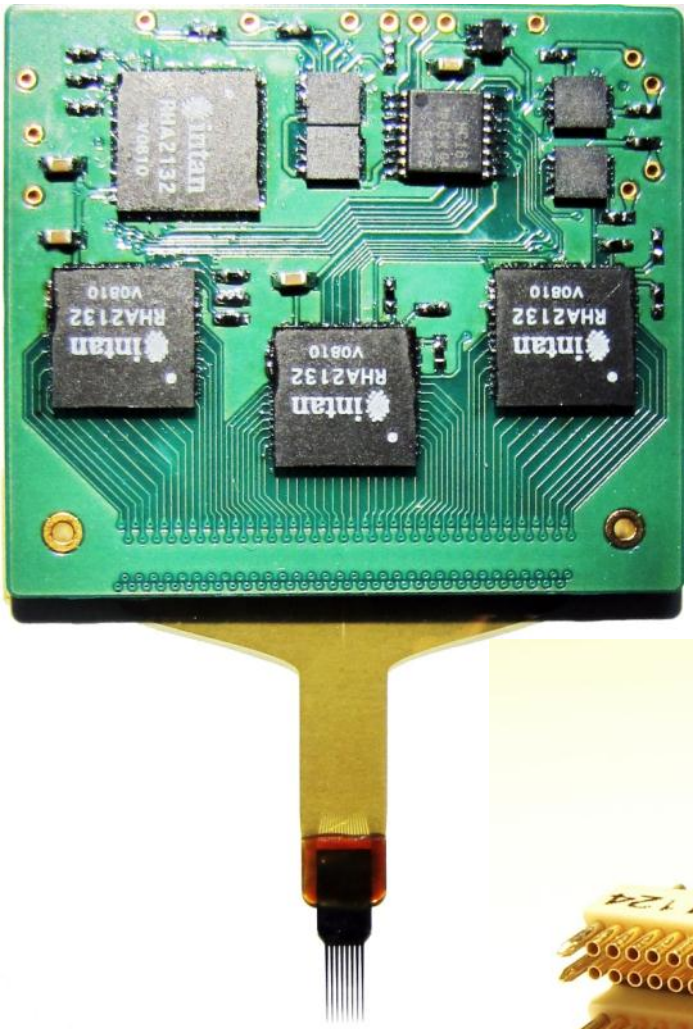


- Input (1-8)
- Channel (1-32)
- Gain of LFP output
- Gain of MUA output
- Buttons:
  - Left-right: move btw options
  - Up-down: change values
- MUA output (to scope)
- LFP output (to Grass audio monitor)



19th window on this screen, Input 5, channel 4 (which is the 131st channel of the 256) (inputs are numbered from 1-8, channels are numbered from 1-32)

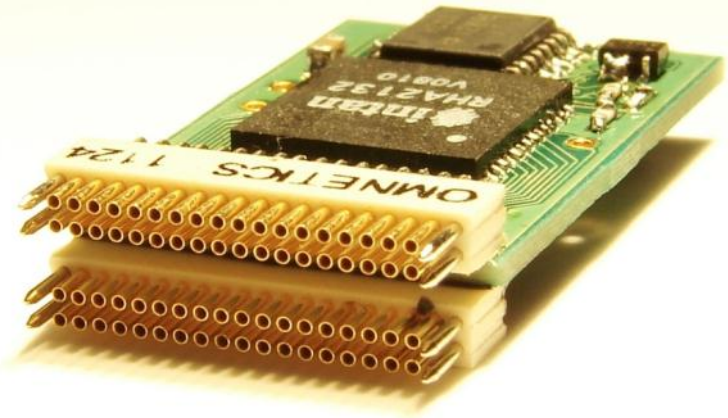
Headstages



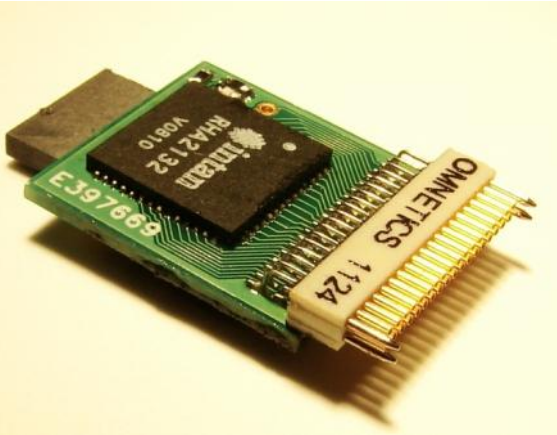
- HS4: 256 ch.

- HS1: 64 ch.

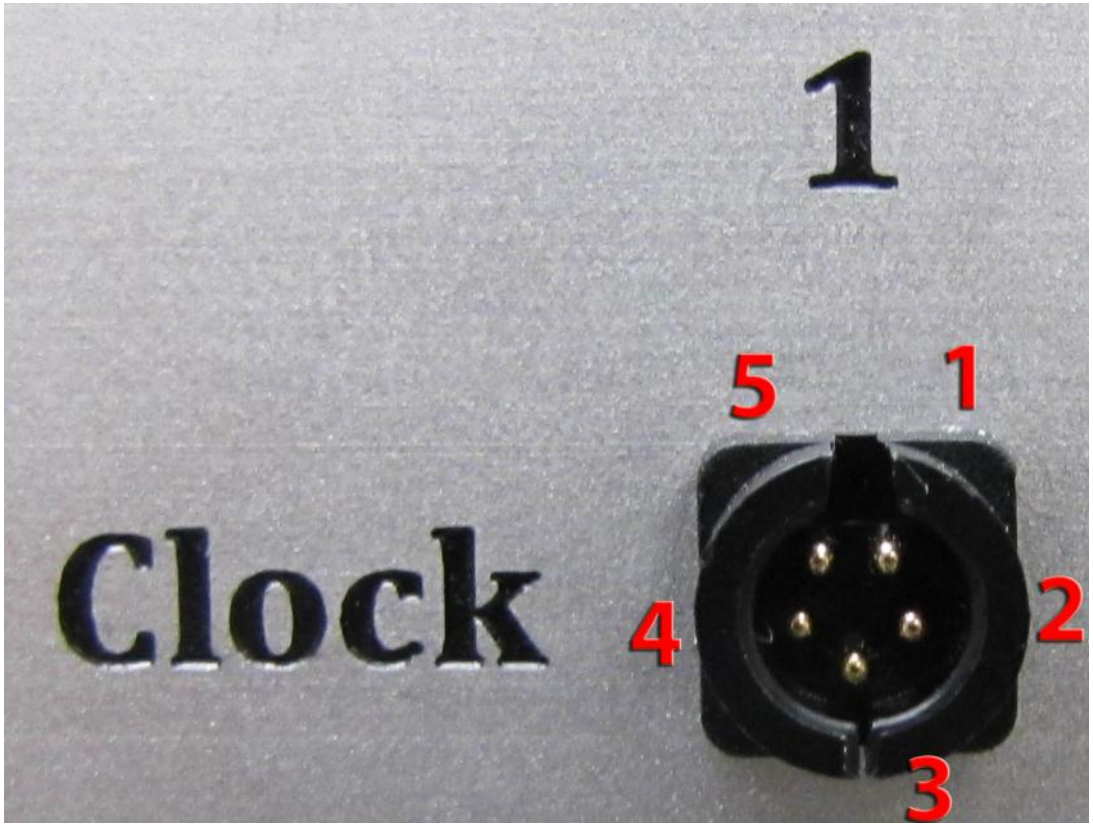
- HS2: 64 ch omnetics



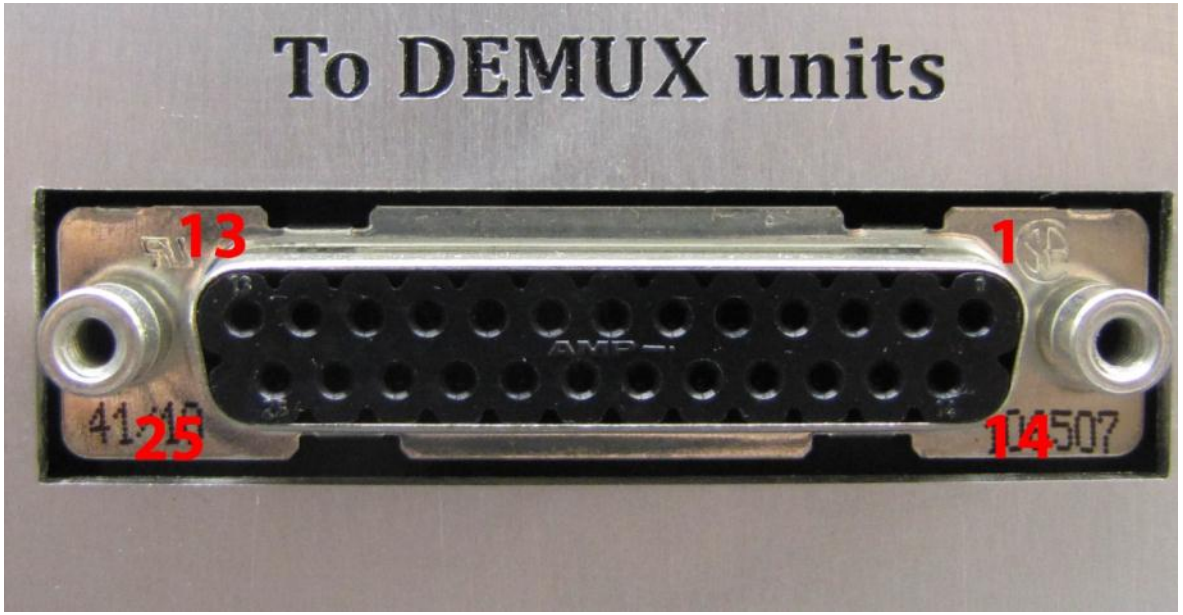
- HS3: 32 ch omnetics



Connector pinouts



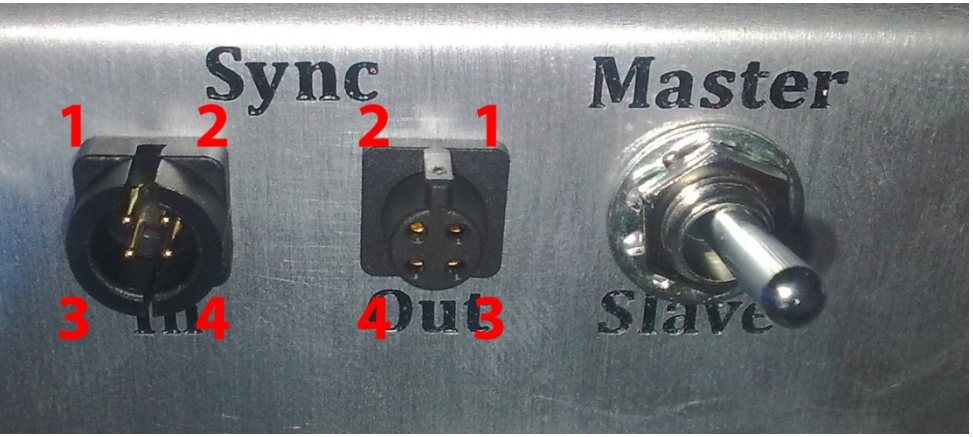
- 1: +5V for LED
- 2: +3.3V (VCC)
- 3: Reset
- 4: GND
- 5: Clock



- 1: Multiplexed Input 1
- 2: Multiplexed Input 2
- 3: Multiplexed Input 3
- 4: Multiplexed Input 4
- 5,6: +5V
- 7: Reset
- 8: Trigger for DAQ card sampling
- 9-10 GND
- 11: Clock bit 0 (Clock)
- 12: Clock bit 4
- 13: Clock bit 3
- 14: Multiplexed Input 14
- 15: Multiplexed Input 15
- 16: Multiplexed Input 16
- 17: Multiplexed Input 17
- 18-19: -5V
- 20-21: +3.3V
- 22-23 GND
- 24: Clock bit 1
- 25: Clock bit 2

- 1: Multiplexed Input 1
- 2: Multiplexed Input 2
- 3: Multiplexed Input 3
- 4: Multiplexed Input 4
- 14: Multiplexed Input 14
- 15: Multiplexed Input 15
- 16: Multiplexed Input 16
- 17: Multiplexed Input 17
- 8-12, 18-24 GND
- 5: +3.3V (VCC)
- 6: Clock
- 7: Reset
- 13,25: +5V (LED)

For devices equipped with system-binder interface



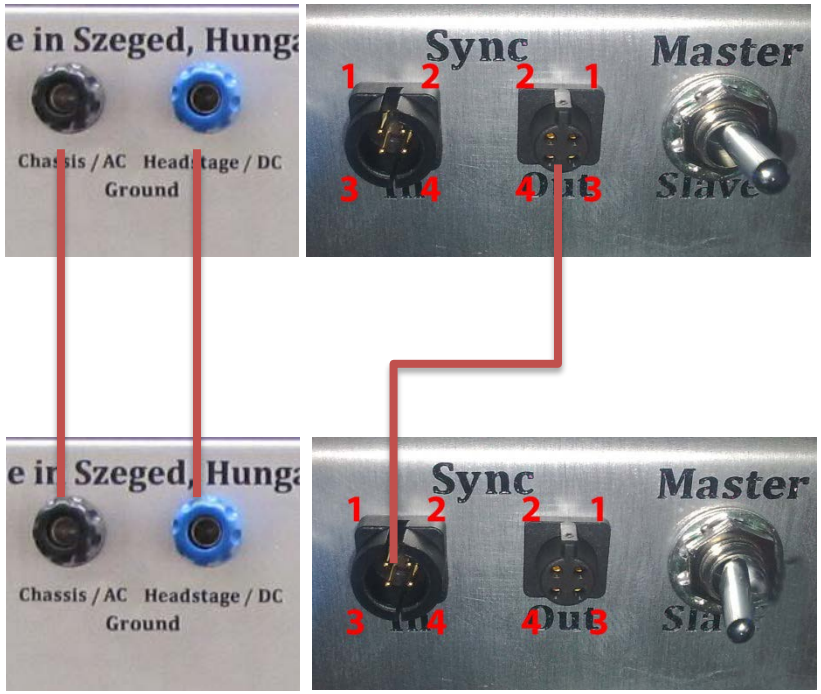
- 1: AC Gnd
- 2: Clock
- 3: Trigger
- 4: Reset

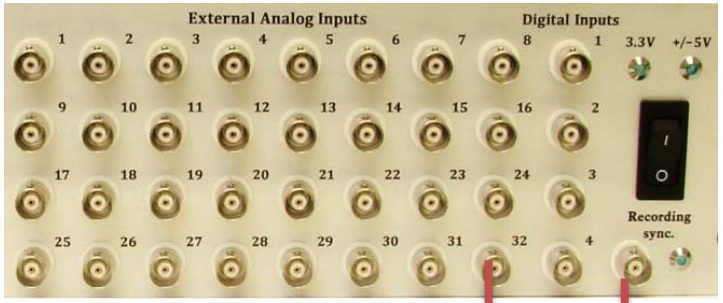
- To synchronize two KJE-1001 devices, in order to record up to 512 channels:
  - Connect the „Sync out" terminal of the „Master" device to the „Sync in" terminal of the Slave device.
  - Connect the mating GND shafts with banana plugs. (AC to AC, DC to DC)
  - To record a sync signal which allows the alignment of the two (master and slave) dat files offline, connect the „Recording sync" output of the „Master device" to an external analog input on both devices. Don't forget to record these channels.
  - Start acquisition on the slave device first, which will wait for the acquisition to start on the master
  - Start recording on the slave first, and stop recording on the master first.

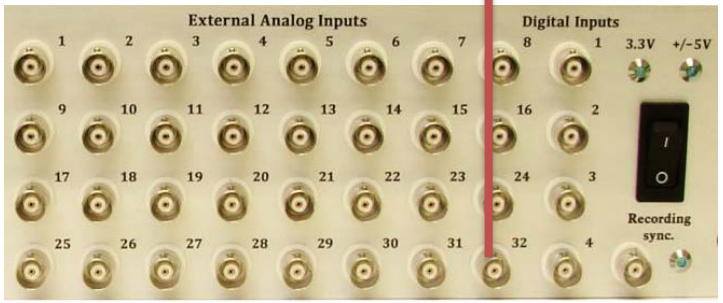
- In standalone mode, the master-slave switch should be in master position.
- The intermediate position of the master-slave switch is not defined.
- Matching connectors: BINDER - 09 9764 70 04 (Sync out) and 09 9767 70 04 (Sync in)

Synchronizing two KJE-1001 devices

Master

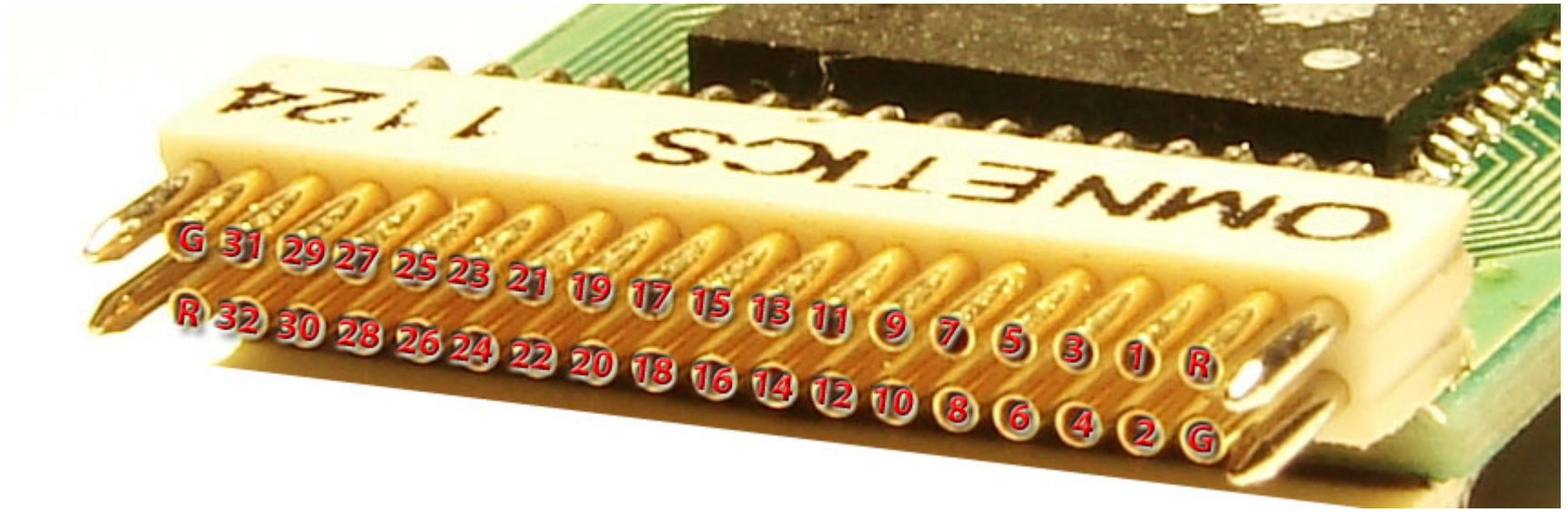




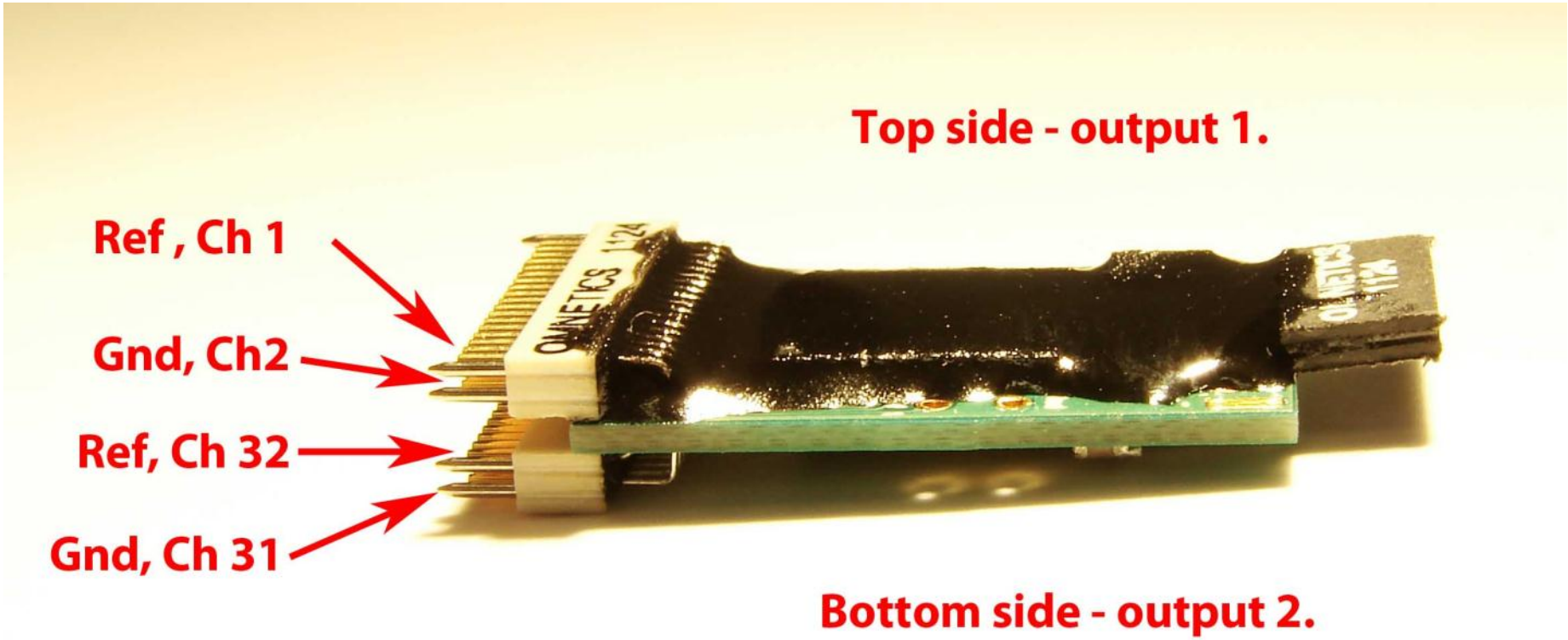


Slave

HS2 and HS3 electrode side connector

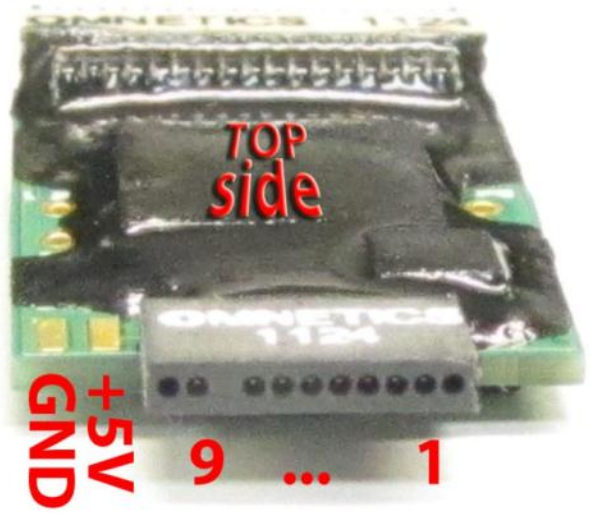


HS2 and HS3 electrode side connector



Warning!
Always connect the cable to the headstage that the „Omnetics” text on the 9 pin connectors should face the same side! Inappropriate connection may permanently damage the headstage!

HS2 and HS3 cable side connector



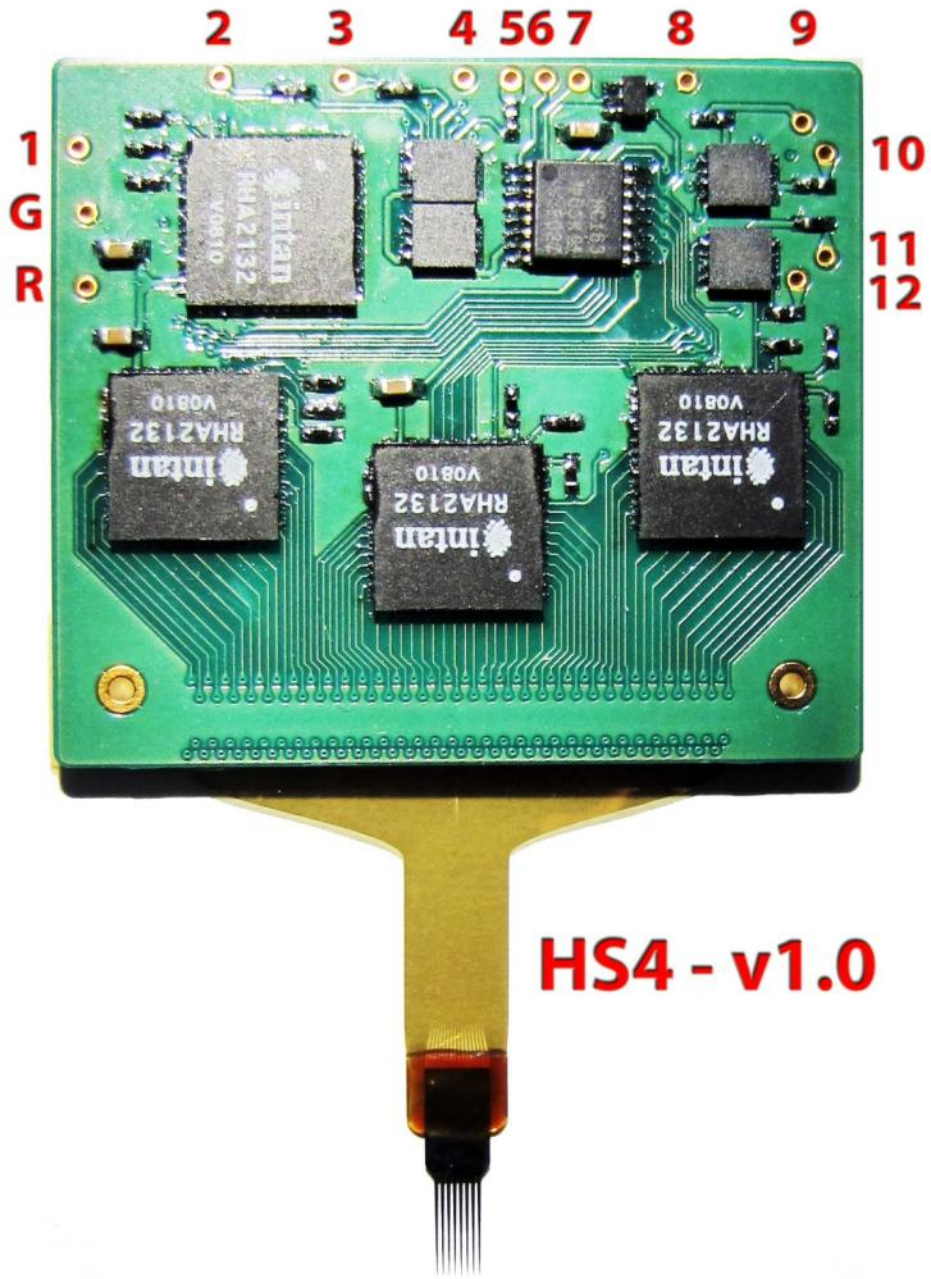
1. Multiplexed output 1. (top side)
2. Multiplexed output 2 . (bottom side)
3. Reset
4. Clock
5. +3.3 V (headstage power)
6-7. GND
8. N/A
9. +5V (optional LED power)

Warning!
Always connect the cable to the headstage that the „Omnetics” text on the 9 pin connectors should face the same side! Inappropriate connection may permanently damage the headstage!

HS1 cable side connection

- 1-2: GND
- 3: Clock
- 4: +3.3V (Vcc)
- 5: Multiplexed output 1
- 6: Multiplexed output 2
- 7: Reset

- G: Ground from animal
- Ref: Reference from animal

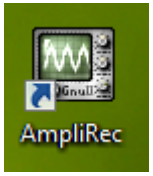


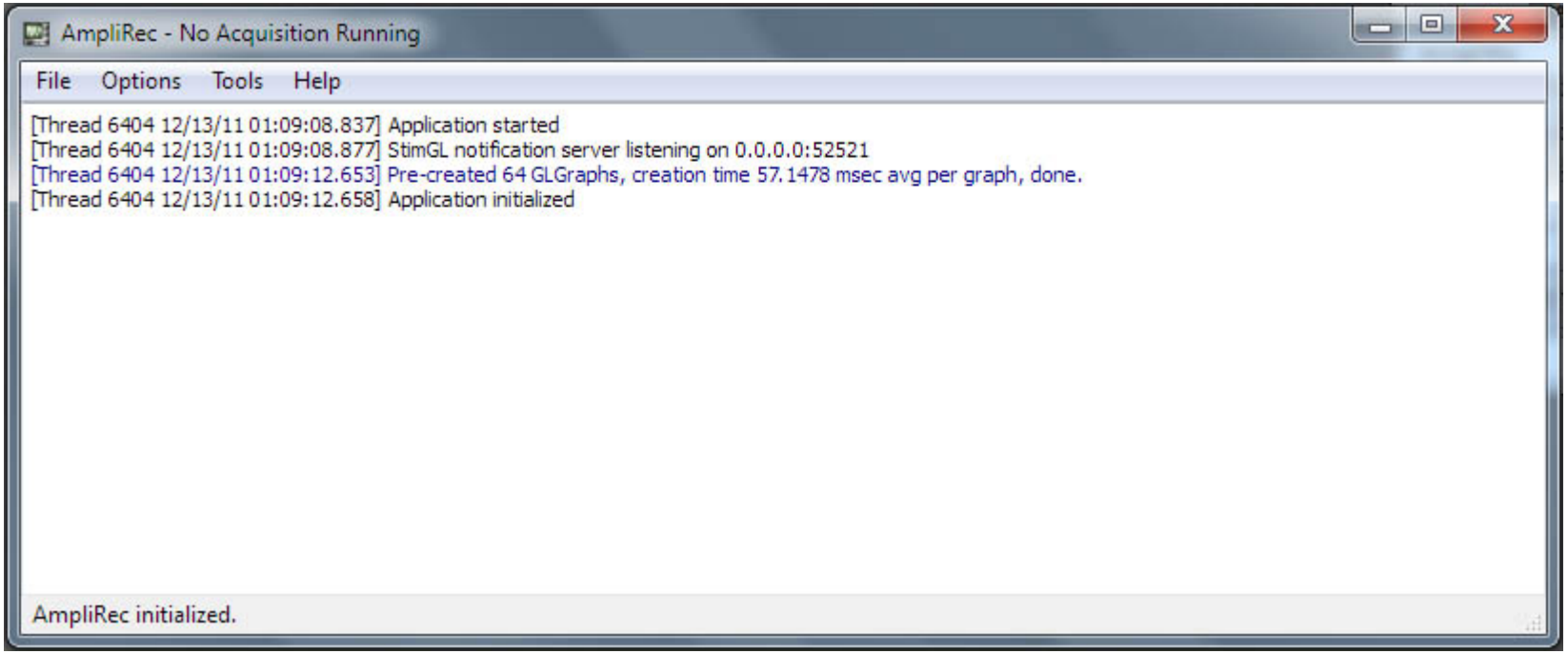
HS4 cable side connection

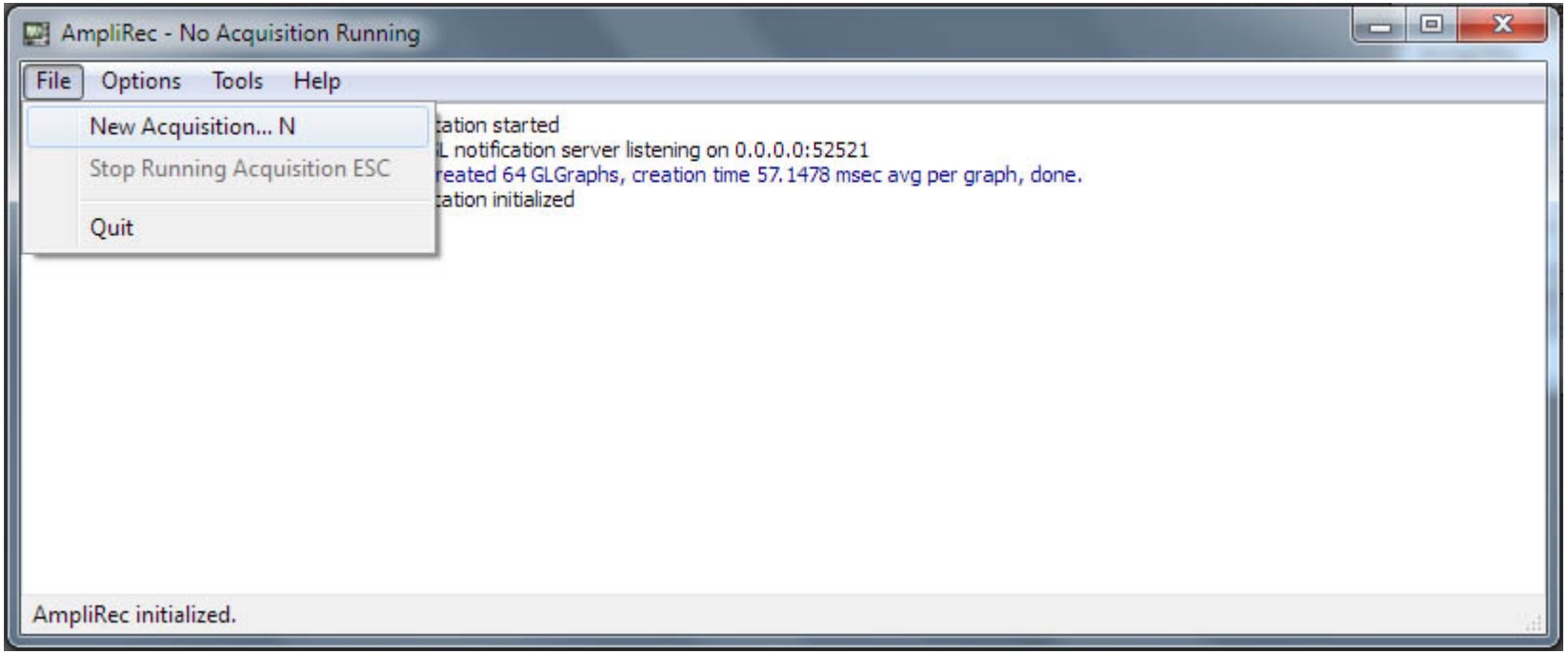
- 1: +3.3V (Vcc)
- 2: Multiplexed output 3
- 3: Multiplexed output 5
- 4: Multiplexed output 4
- 5: Multiplexed output 6
- 6: Reset
- 7: Clock
- 8: GND
- 9: Multiplexed output 7
- 10: Multiplexed output 2
- 11: Multiplexed output 8
- 12: Multiplexed output 1

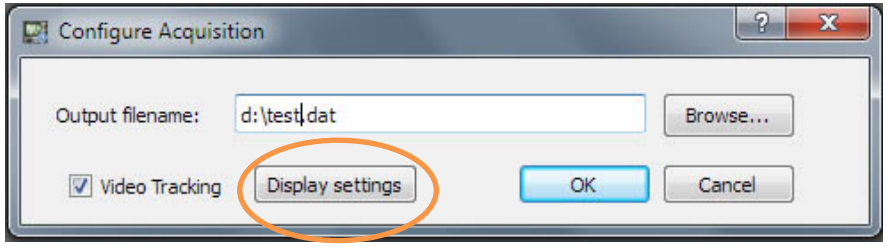
- G: Ground from animal
- Ref: Reference from animal

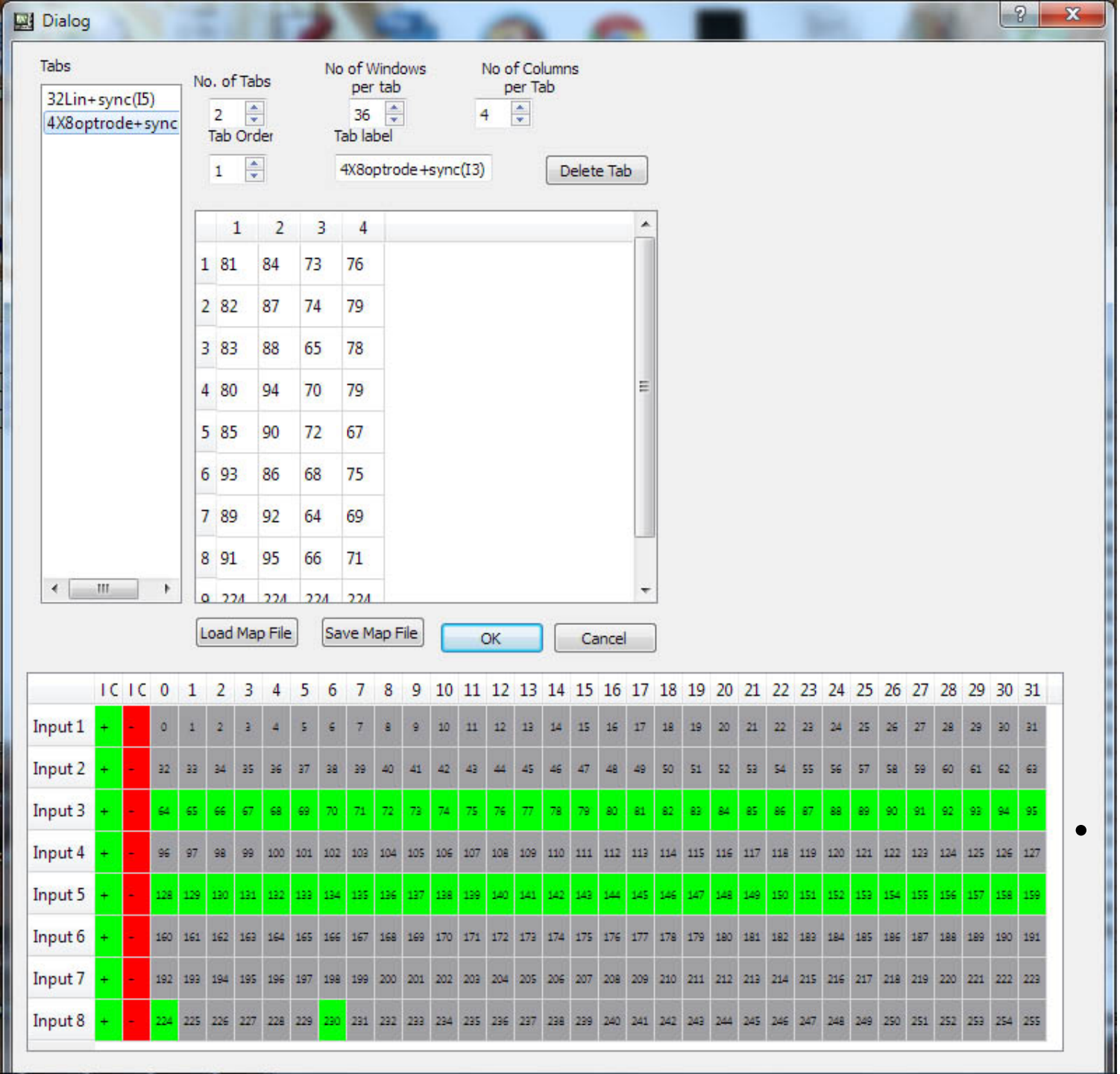
Software - AmpliRec





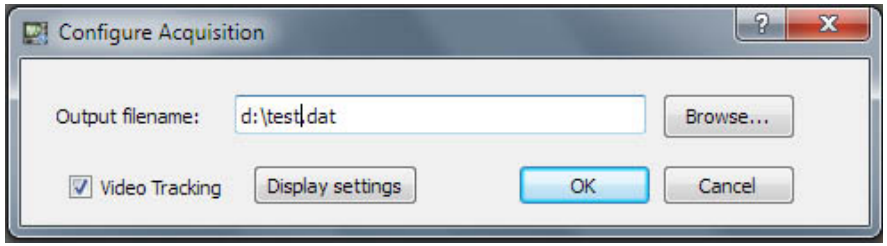

AmpliRec - No Acquisition Running
File
Options
Tools
Help
New Acquisition... N
Stop Running Acquisition ESC
Quit
tation started
iL notification server listening on 0.0.0.0:52521
reated 64 GLGraphs, creation time 57.1478 msec avg per graph, done.
tation initialized
AmpliRec initialized.

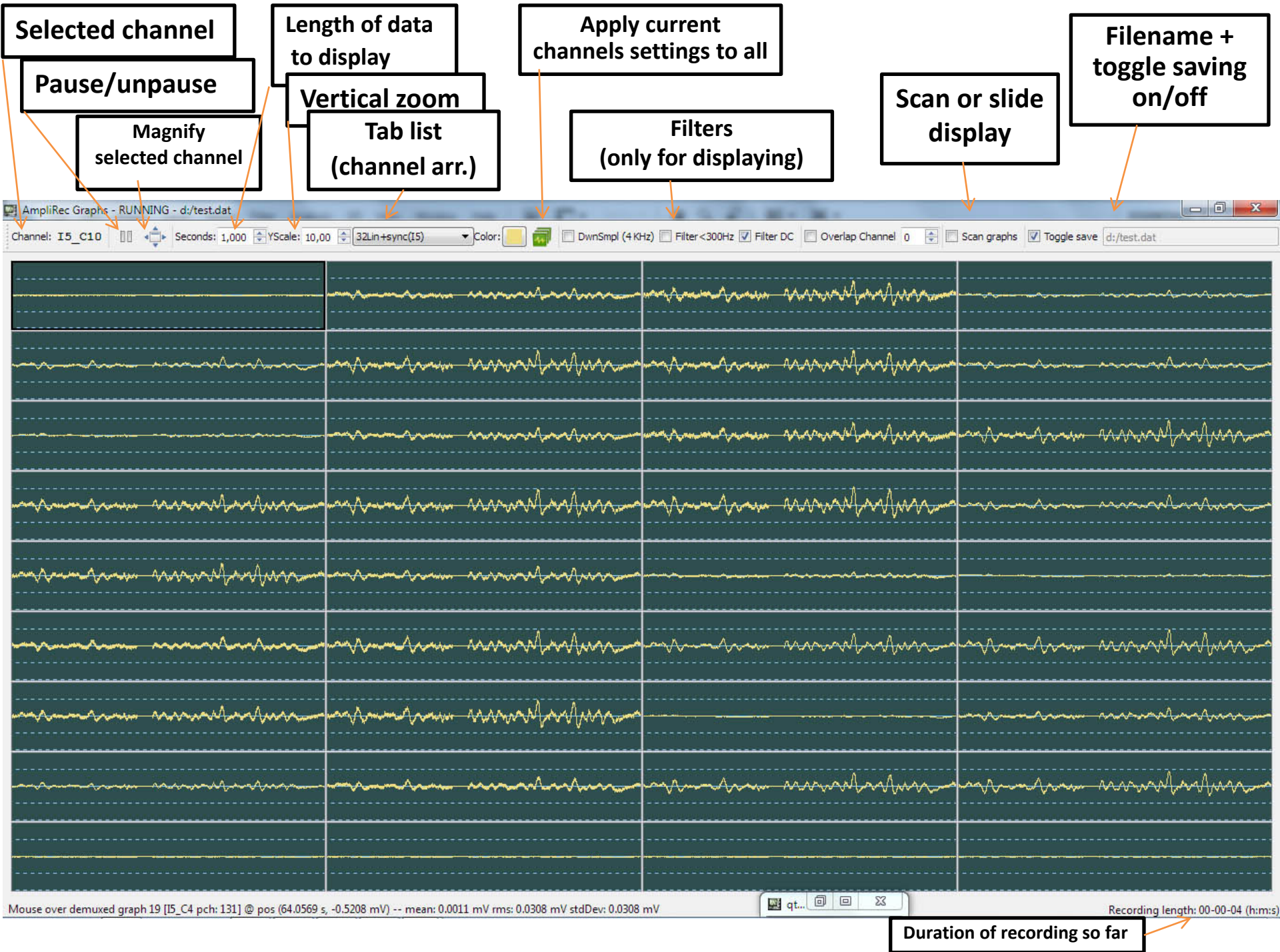

Configure Acquisition
Output filename:
d:\test.dat
Browse...
Video Tracking
Display settings
OK
Cancel



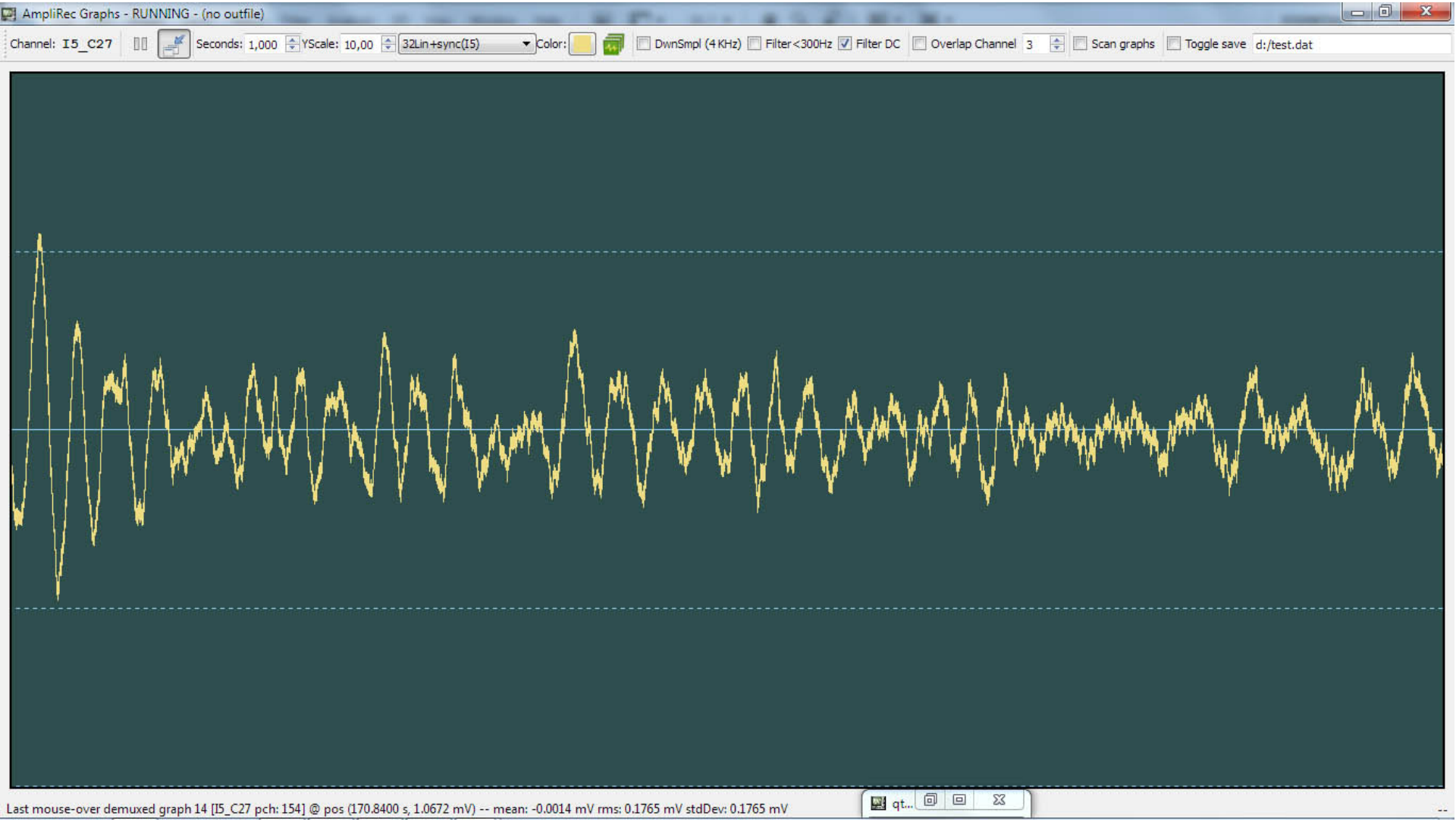
	IC	IC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Input 1	+	-	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Input 2	+	-	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
Input 3	+	-	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
Input 4	+	-	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127
Input 5	+	-	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159
Input 6	+	-	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191
Input 7	+	-	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223
Input 8	+	-	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255

- Only selected channels are saved to disk (greens)!

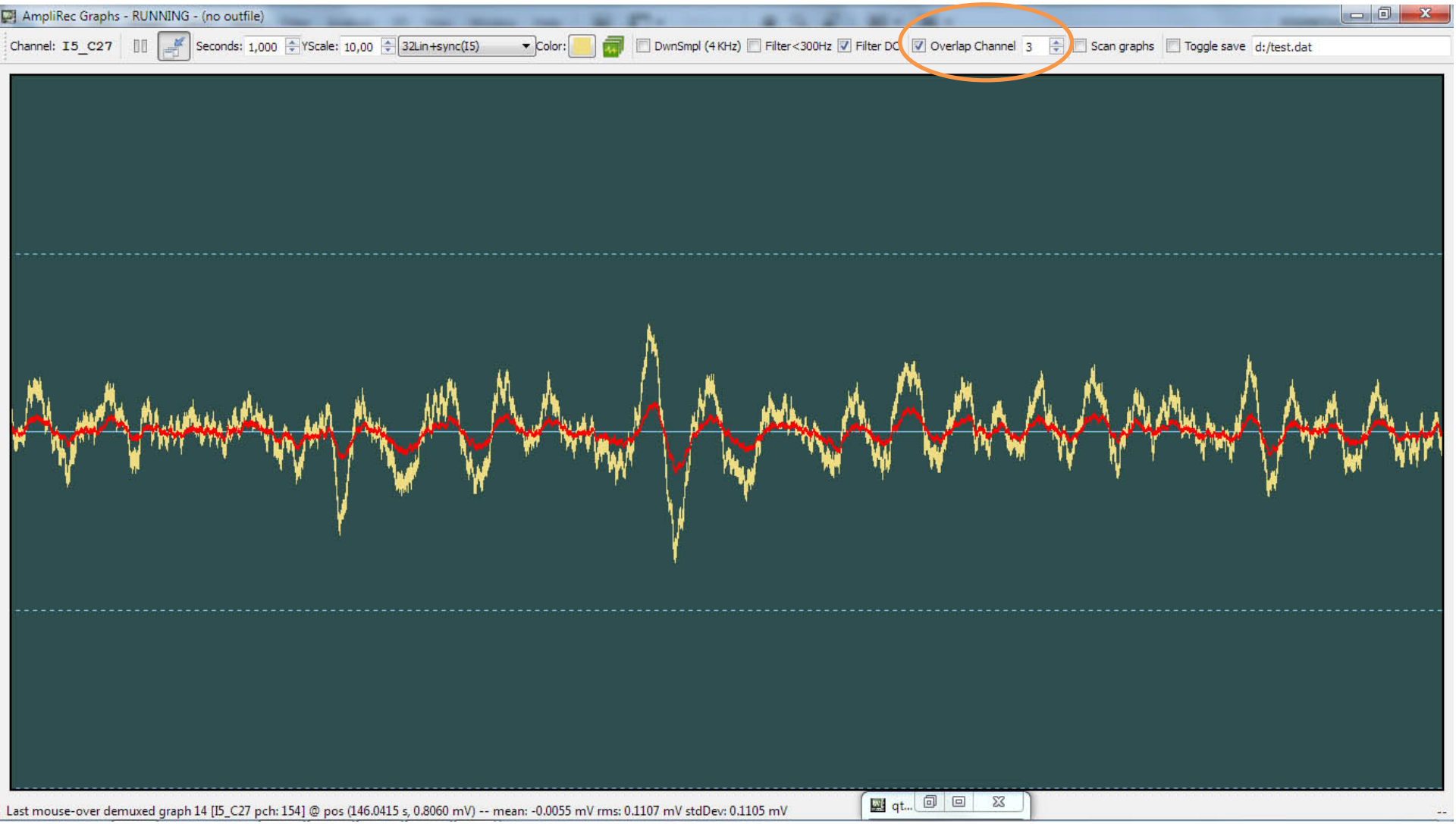

Configure Acquisition
Output filename:
d:\test.dat
Browse...
Video Tracking
Display settings
OK
Cancel


Selected channel
Pause/unpause
Magnify selected channel
Length of data to display
Vertical zoom
Tab list (channel arr.)
Apply current channels settings to all
Filters (only for displaying)
Scan or slide display
Filename + toggle saving on/off
AmpliRec Graphs - RUNNING - d:/test.dat
Channel: I5_C10
Seconds: 1,000
YScale: 10,00
32Lin+sync(I5)
Color:
DwnSmpl (4 KHz)
Filter<300Hz
Filter DC
Overlap Channel
0
Scan graphs
Toggle save
d:/test.dat
Mouse over demuxed graph 19 [I5_C4 pch: 131] @ pos (64.0569 s, -0.5208 mV) -- mean: 0.0011 mV rms: 0.0308 mV stdDev: 0.0308 mV
Recording length: 00-00-04 (h:m:s)
Duration of recording so far

Zoom in/out a channel: double-click



Overlay an extra channel



Channels are numbered here based on their window number on the current tab!

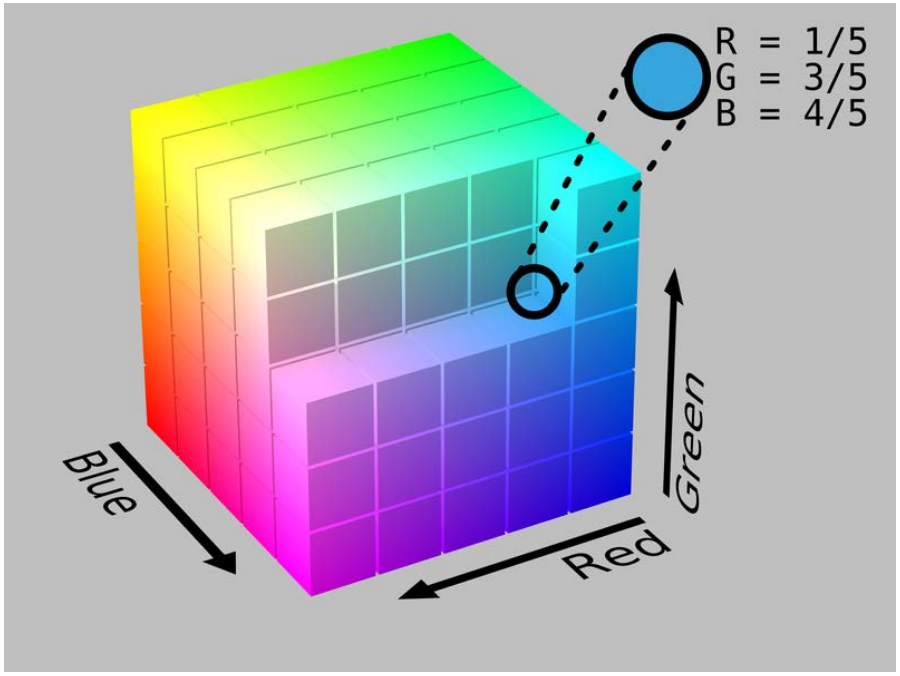
Video tracking

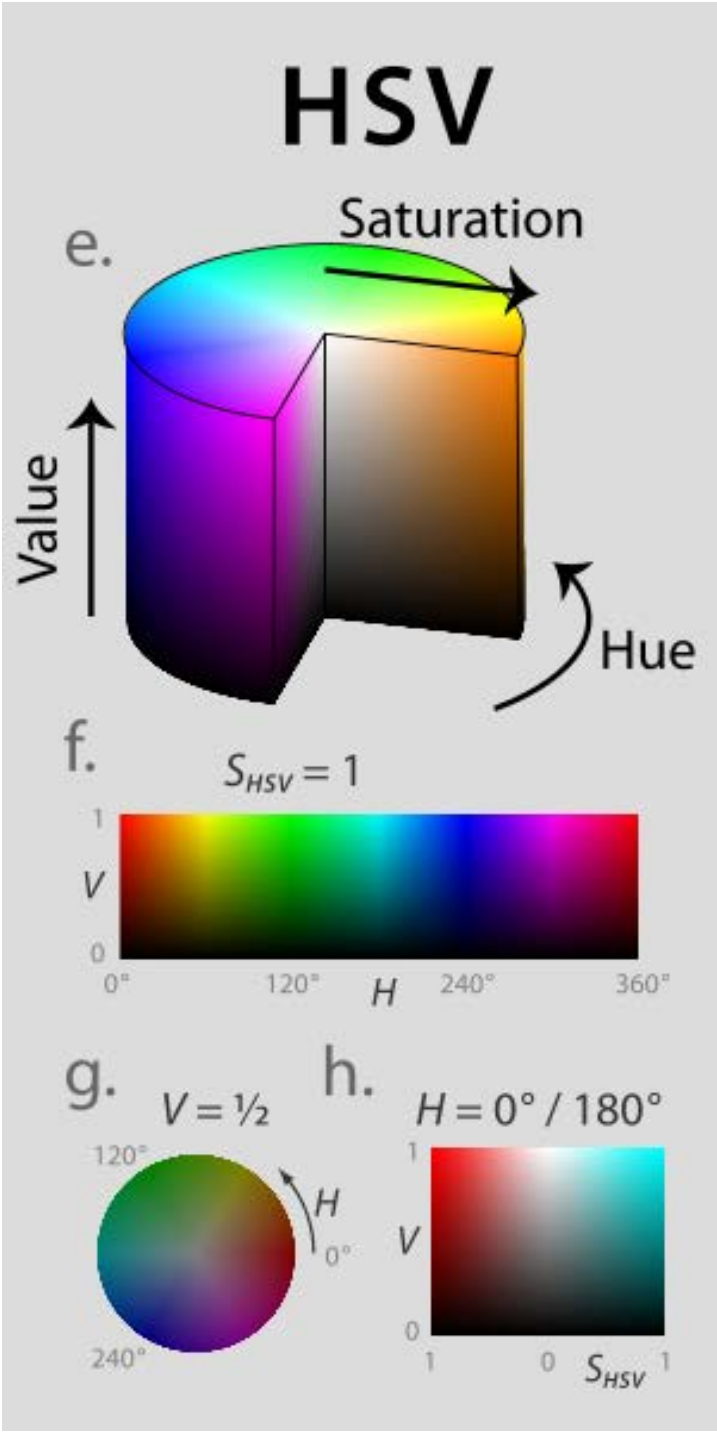
- Recording of raw video in mpg file
- Recording of up to 3 LED positions
- Both

- Framerate approx 30 fps

The HSV colorspace

RGB

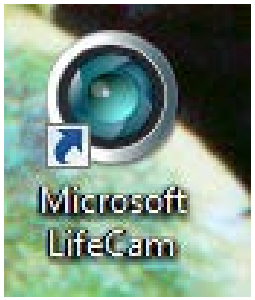


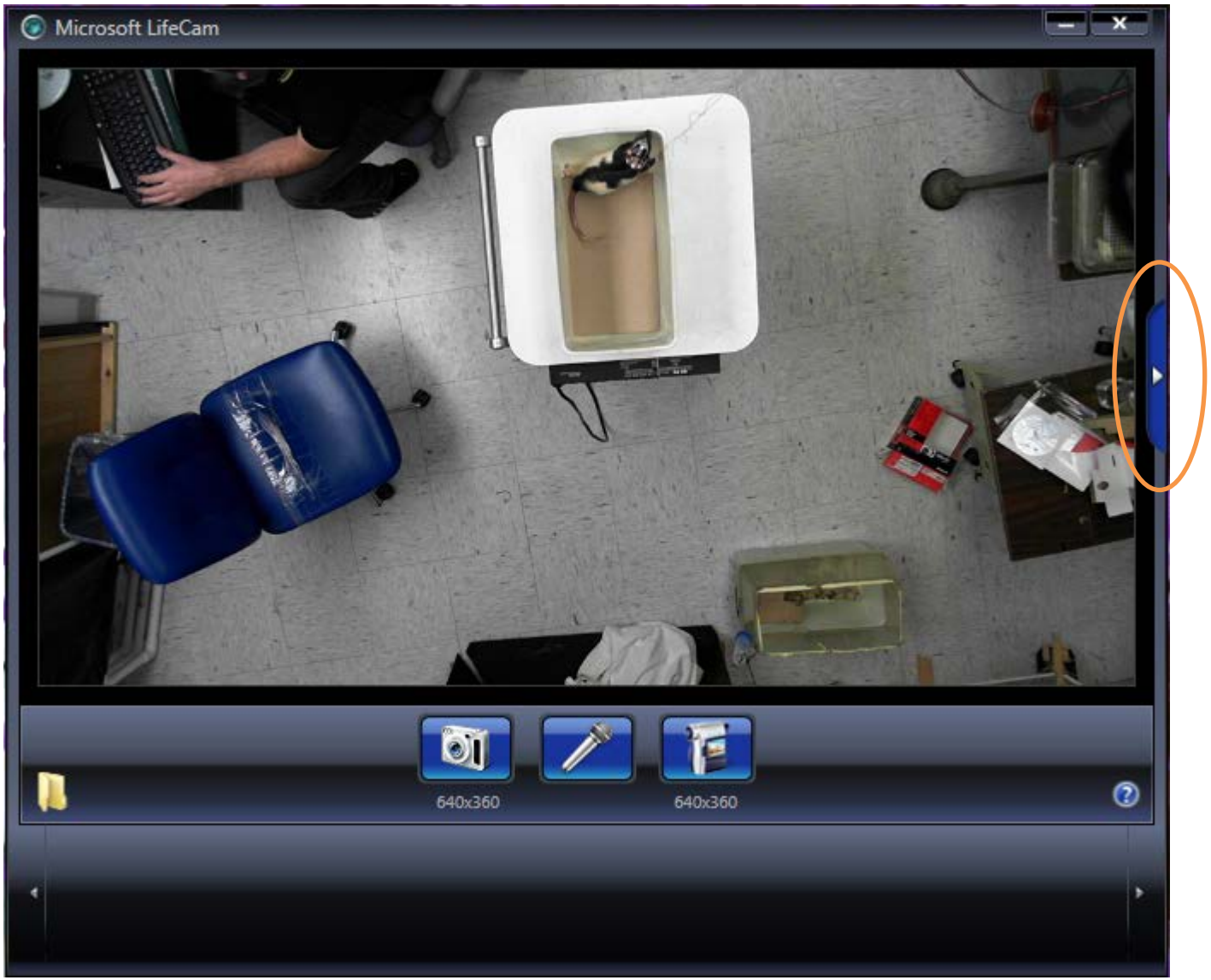


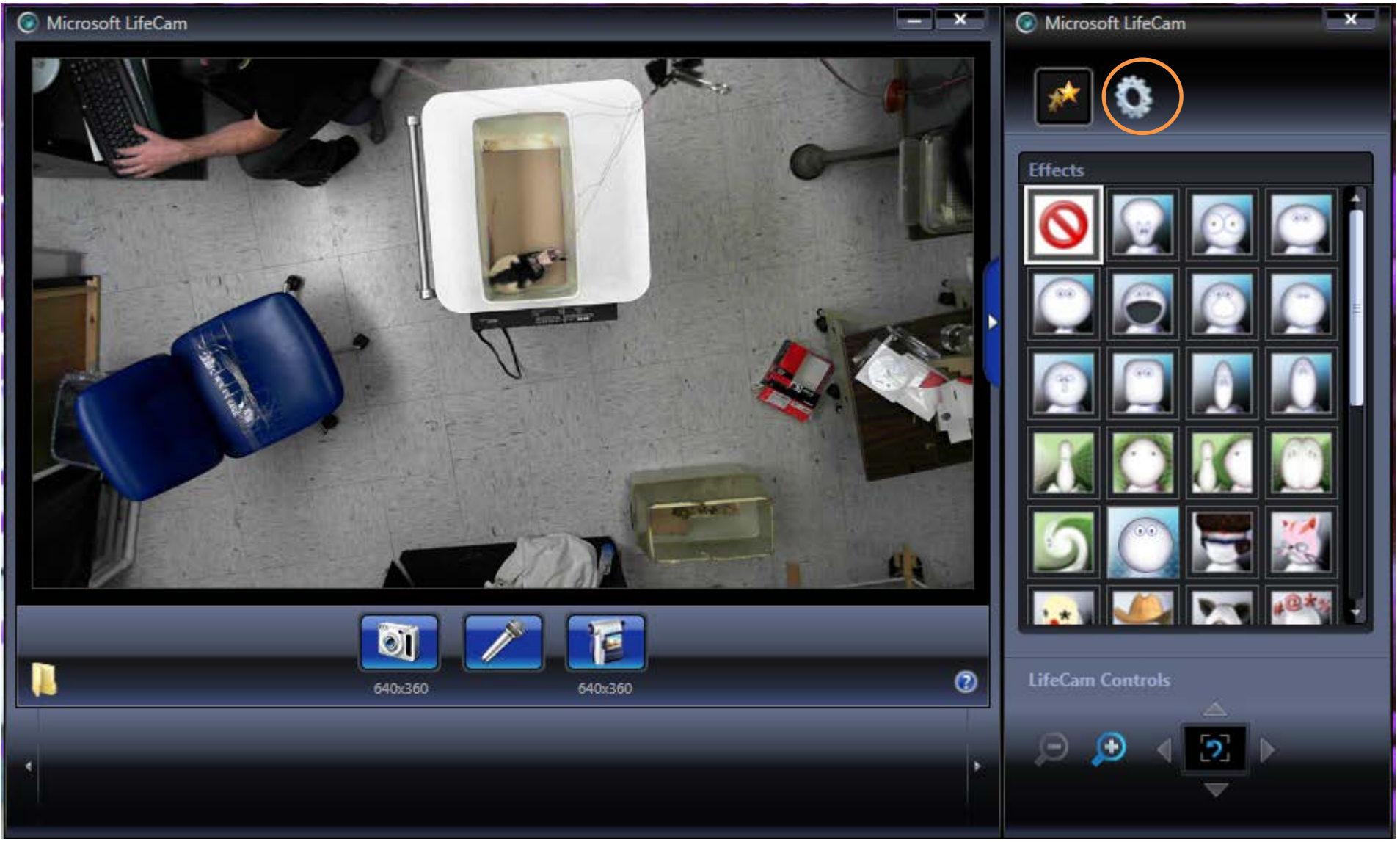
Object detection

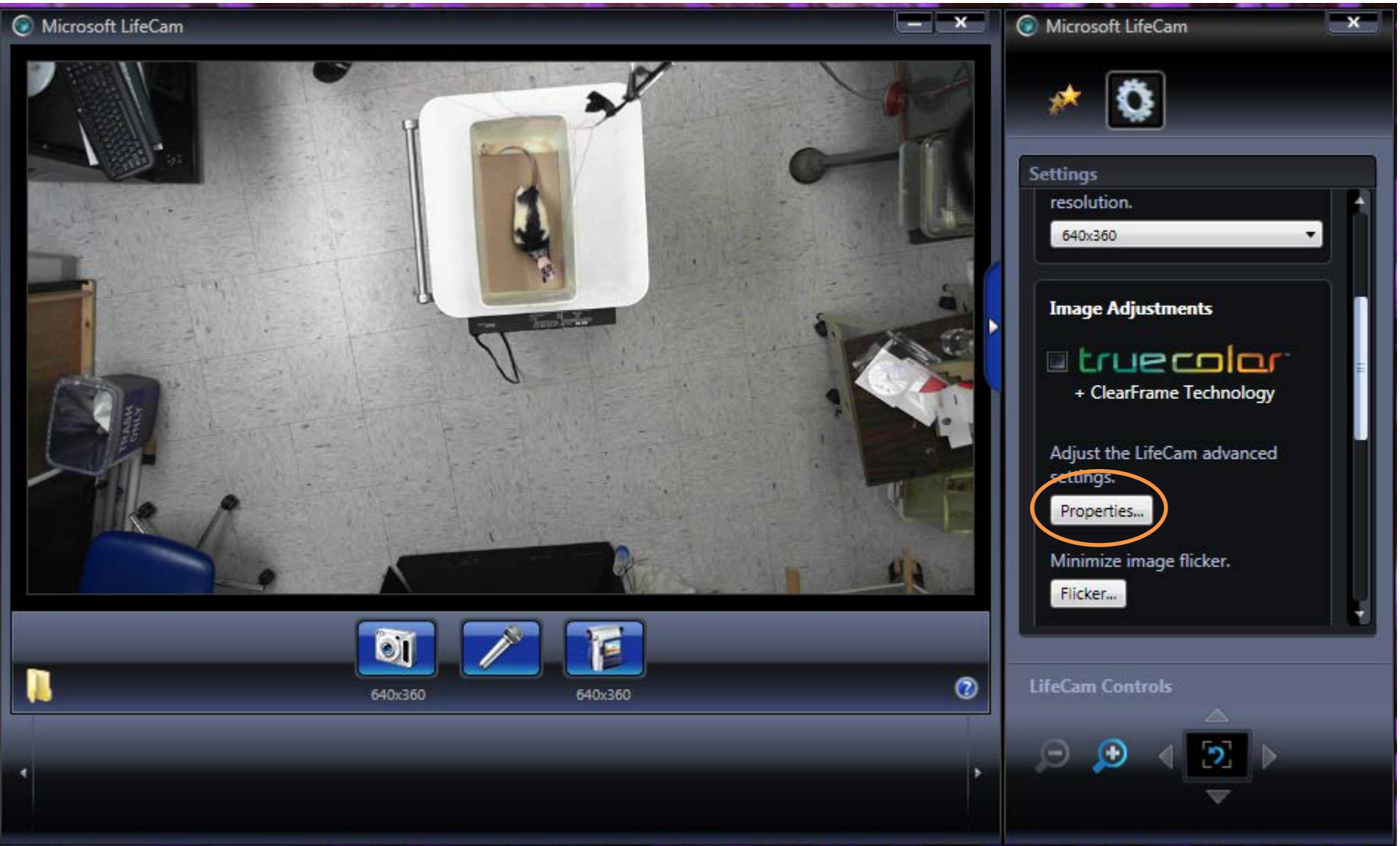
- Steps to detect 1 LED:
  - Filtering image for the specified color range
    - 3 conjunctional filters (Hue, Saturation, Value)
  - Detecting blobs on binary image
  - Discarding small blobs
  - Selecting the largest blob
  - Determining the center of mass
  - (If there are no blobs, coordinates are X:-1 Y:-1)

Initial adjustment of the webcam

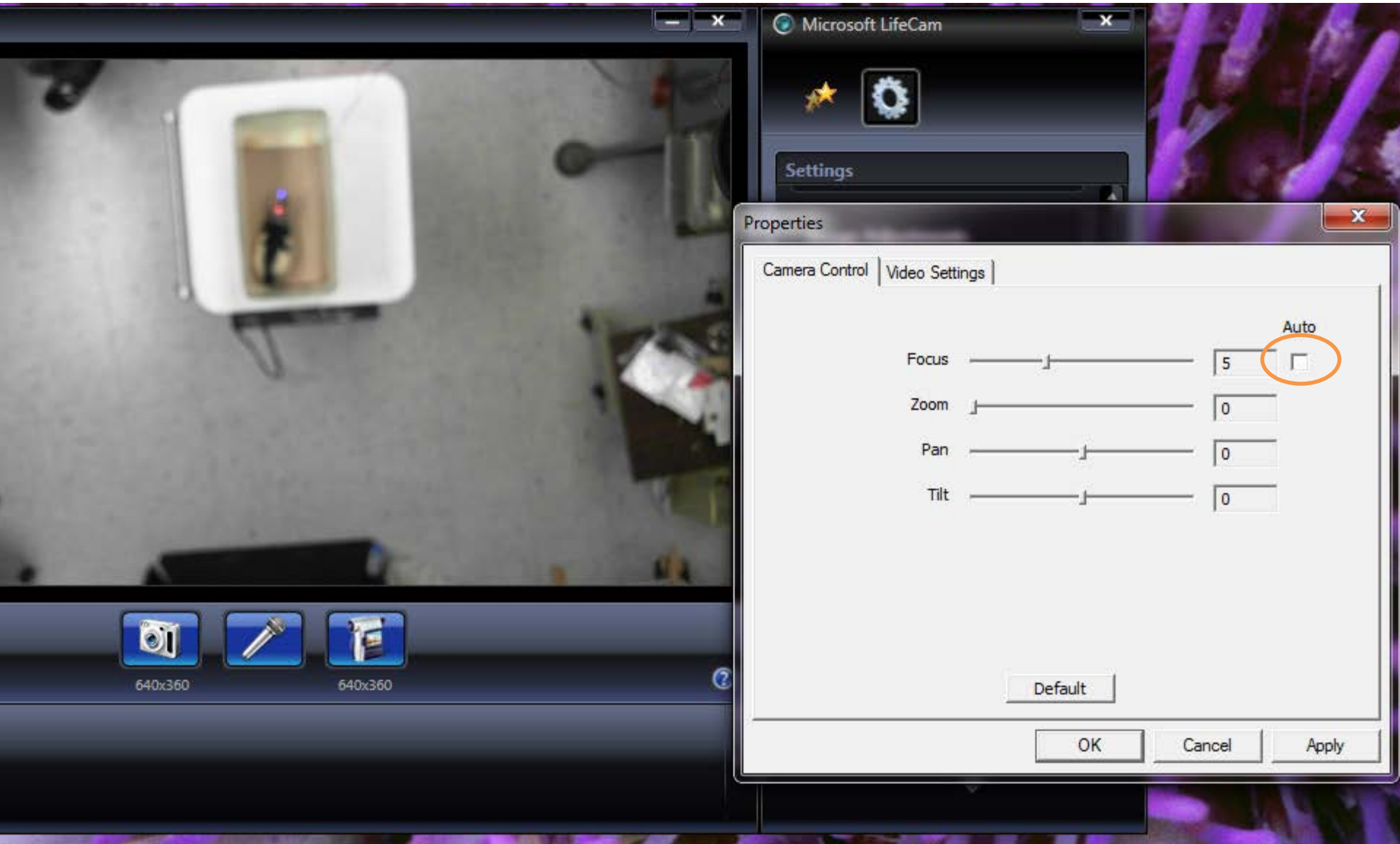




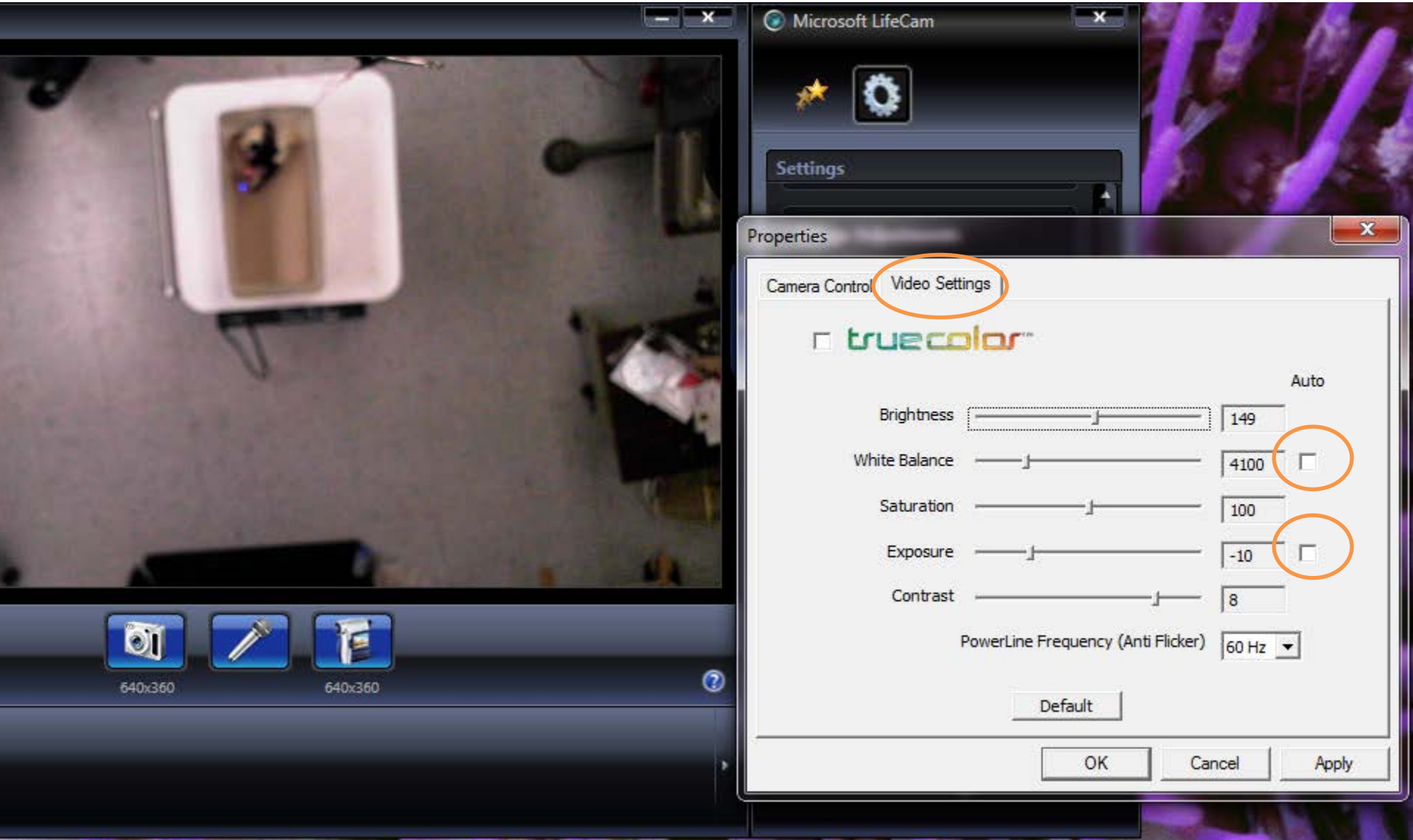

Microsoft LifeCam
640x360
640x360
Microsoft LifeCam
Effects
LifeCam Controls


Microsoft LifeCam
640x360
640x360
Microsoft LifeCam
Settings
resolution.
640x360
Image Adjustments
truecolor
+ ClearFrame Technology
Adjust the LifeCam advanced settings.
Properties...
Minimize image flicker.
Flicker...
LifeCam Controls

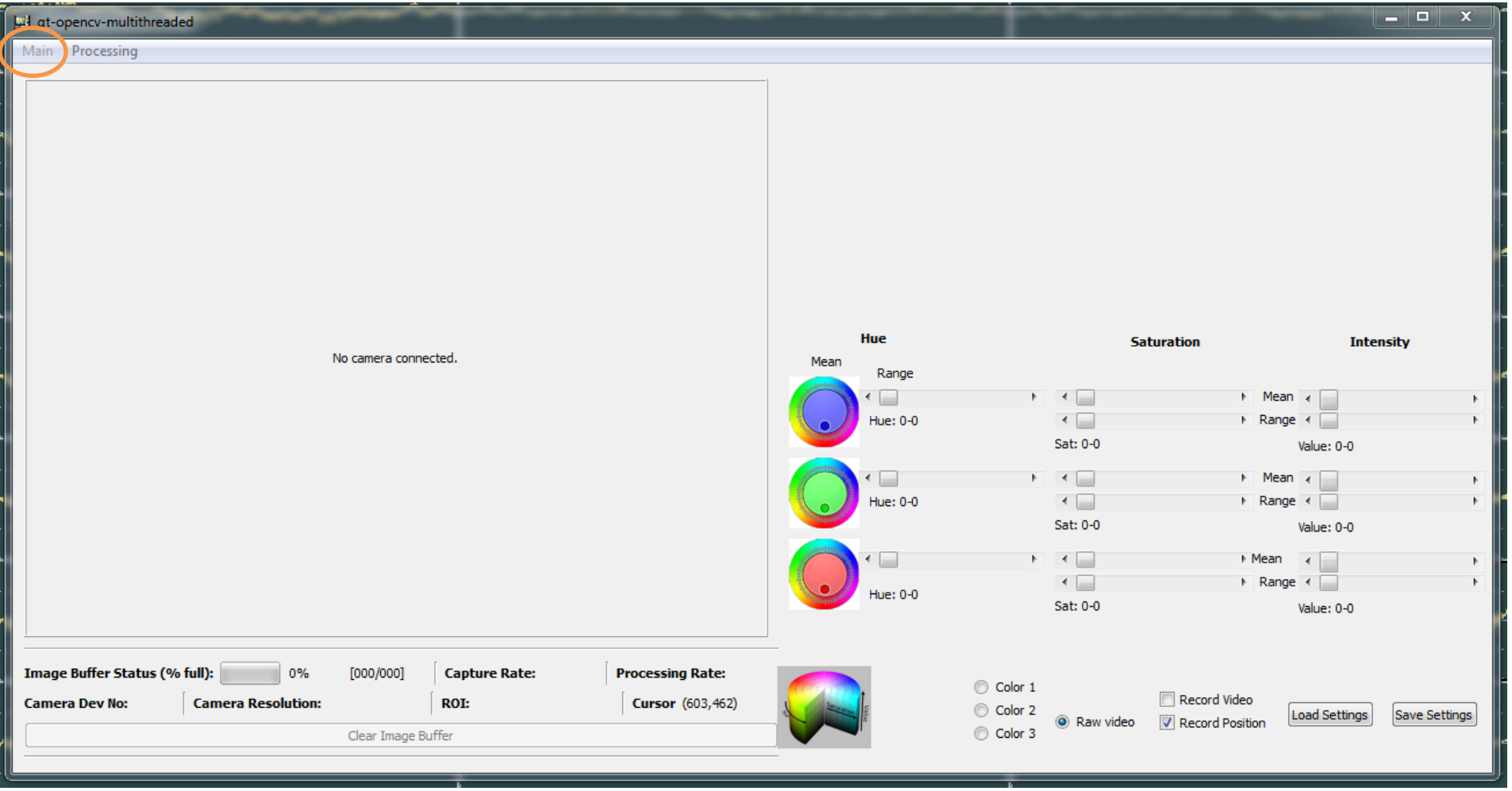
Deselect autofocus, and blur picture

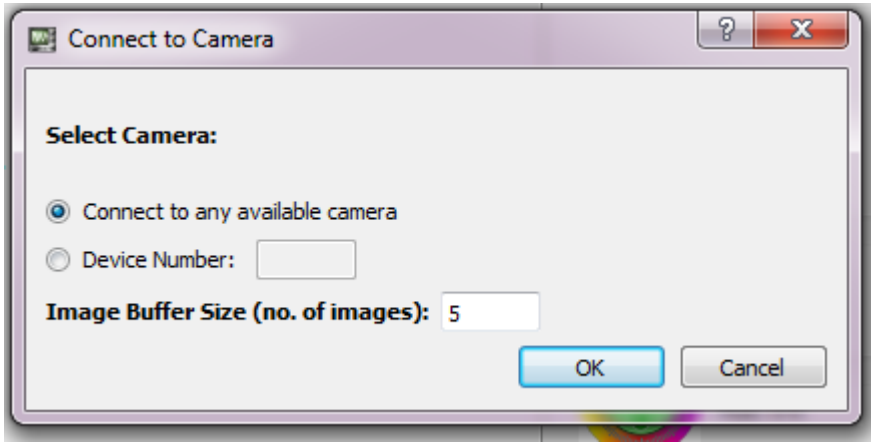


Deselect every automatic settings, set contrast and exposure manually

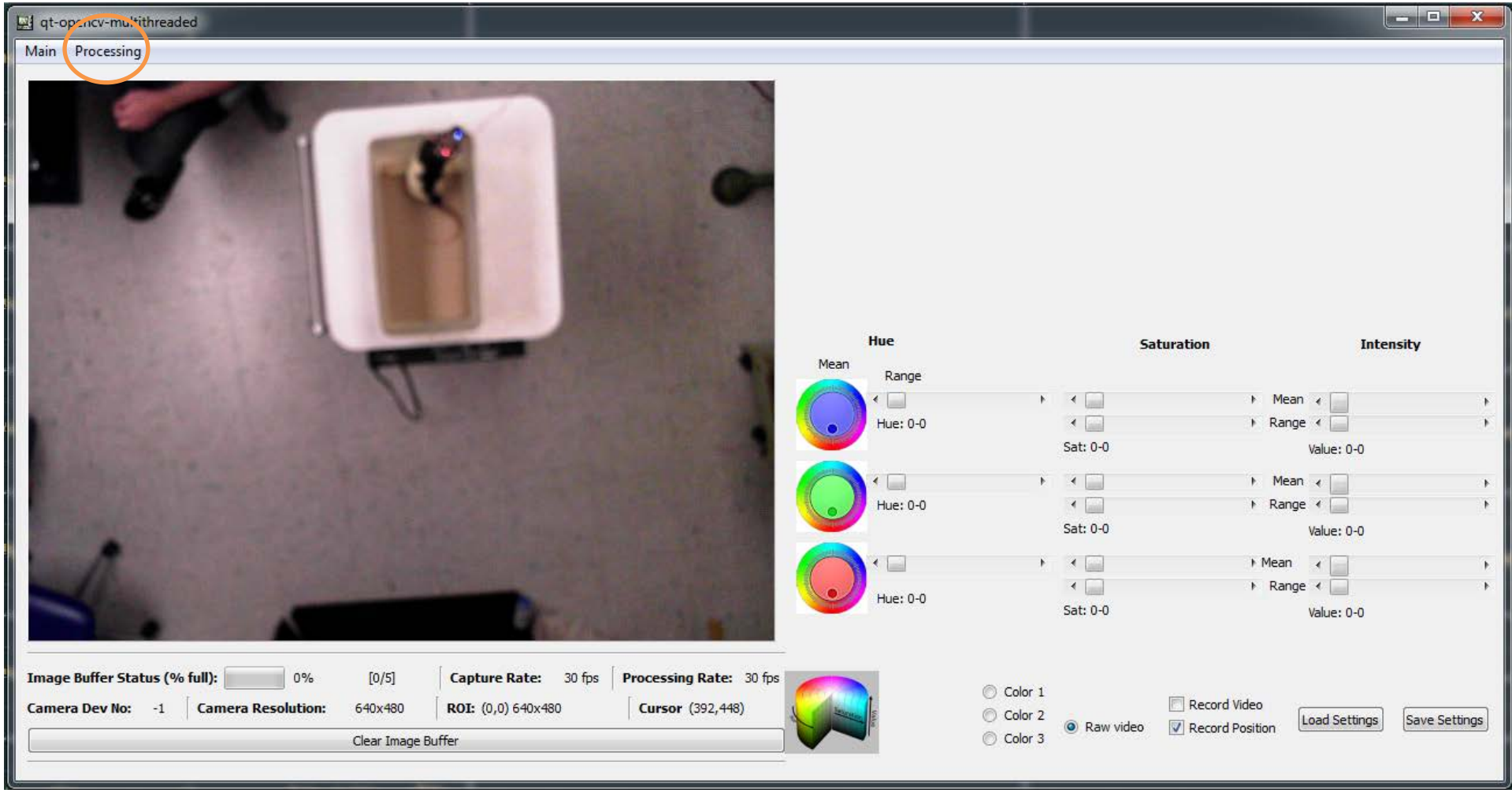


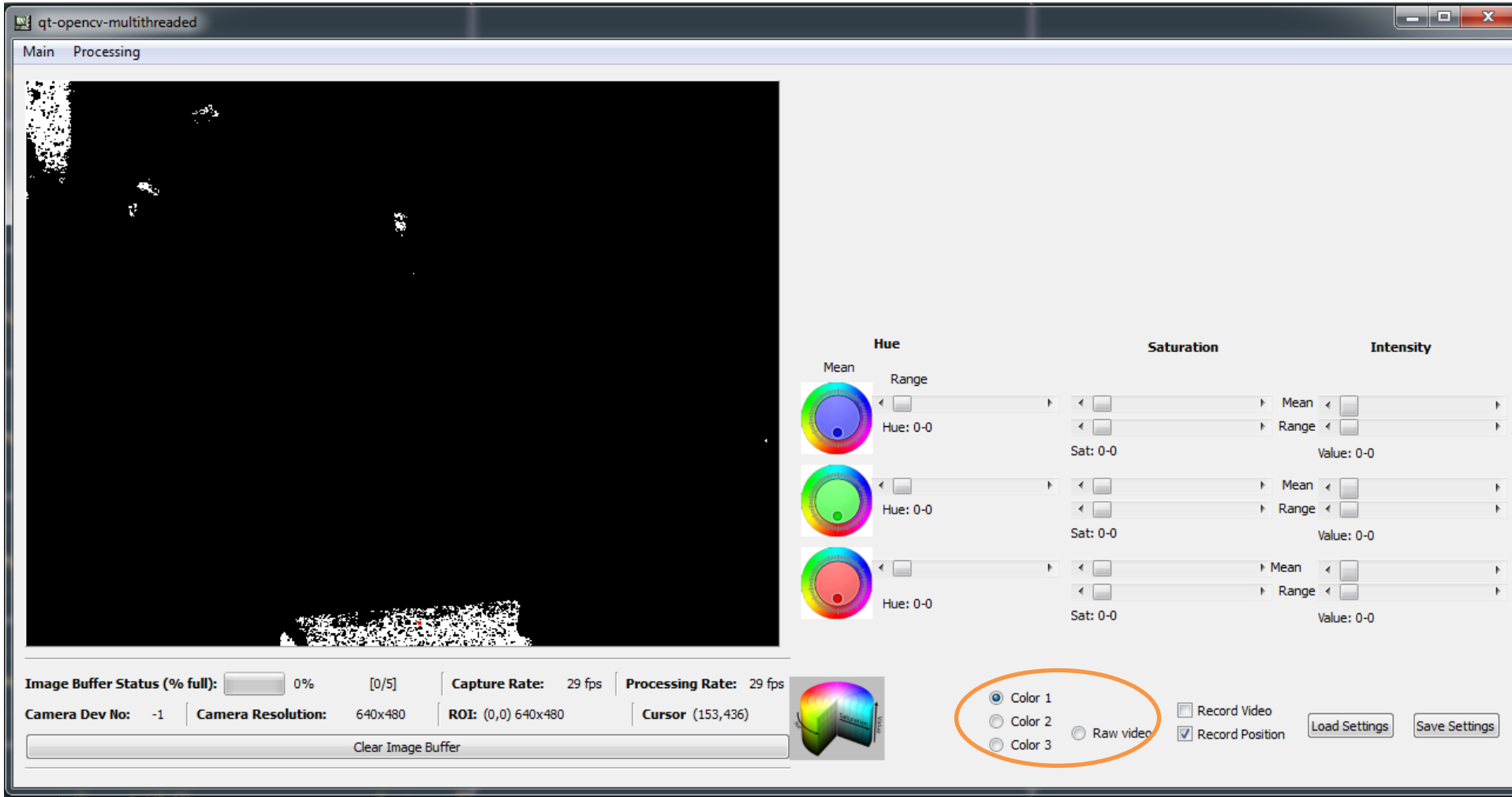
After closing Lifeview window go to tracking window of Amplirec and in themain menu select connect to camera



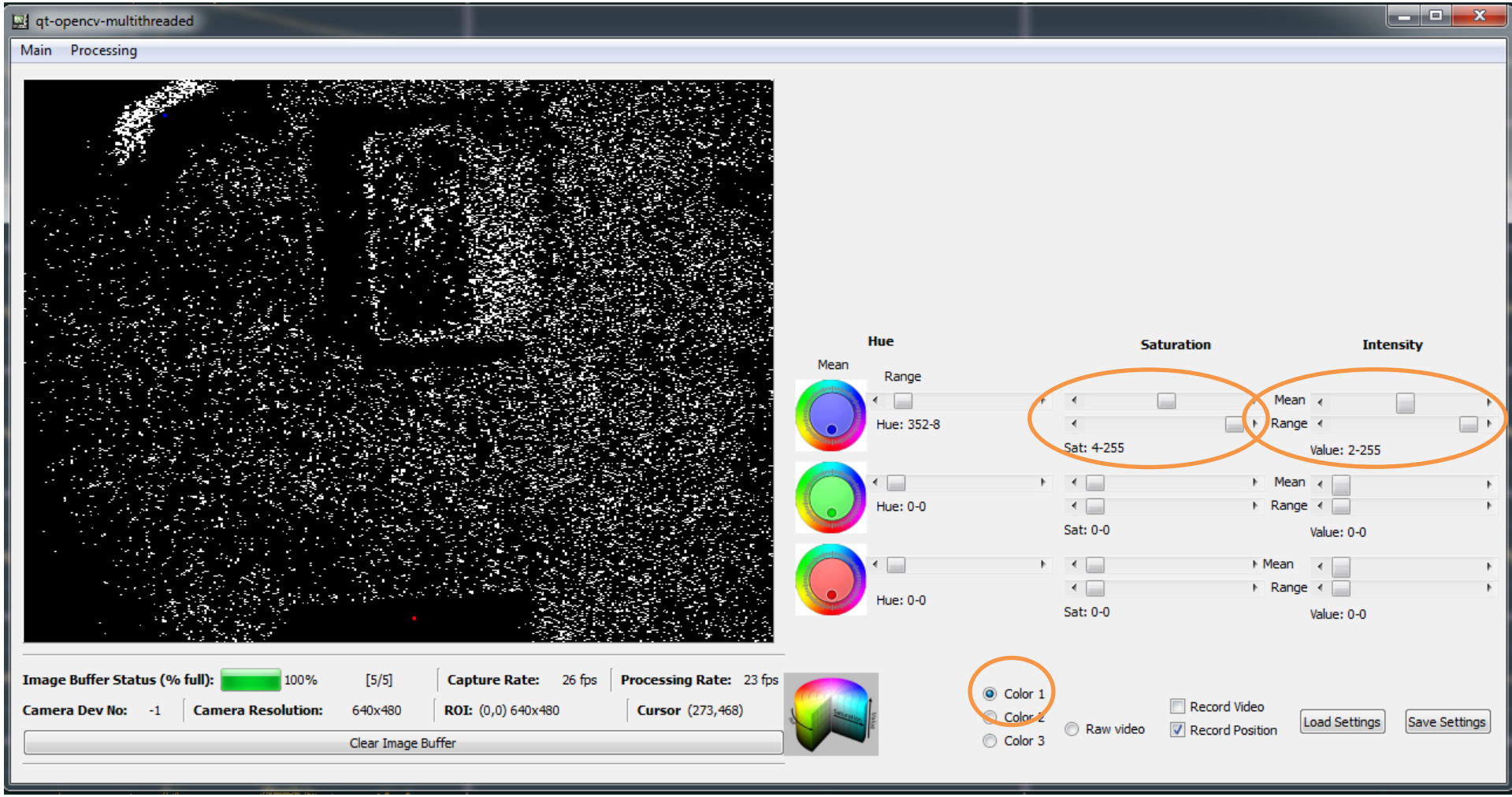

Connect to Camera
Select Camera:
Connect to any available camera
Device Number:
Image Buffer Size (no. of images):
5
OK
Cancel

In processing menu select object detection

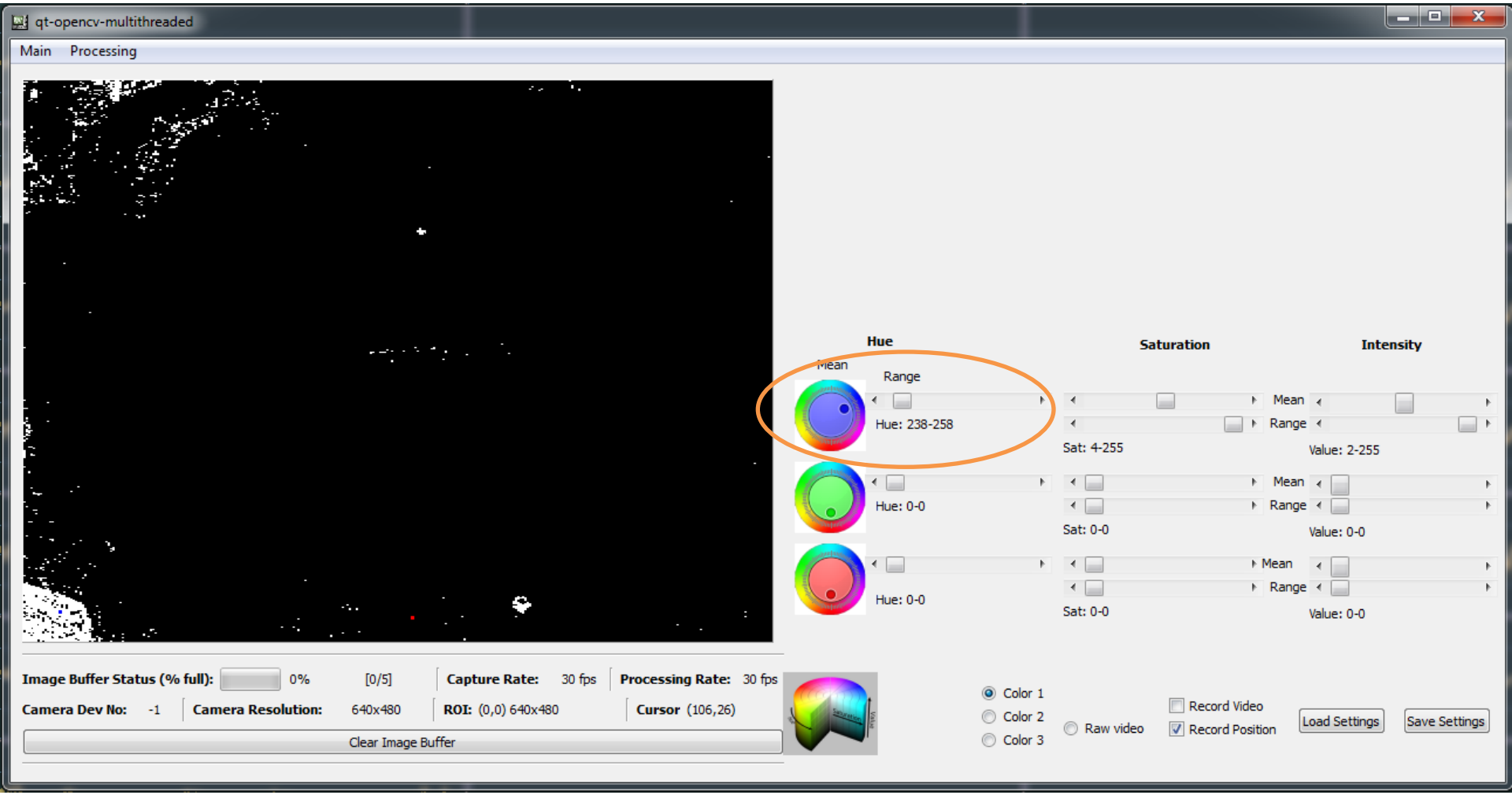



qt-opencv-multithreaded
Main
Processing
Hue
Saturation
Intensity
Mean
Range
Hue: 0-0
Sat: 0-0
Value: 0-0
Image Buffer Status (% full):
0%
[0/5]
Capture Rate:
29 fps
Processing Rate:
29 fps
Camera Dev No:
-1
Camera Resolution:
640x480
ROI:
(0,0) 640x480
Cursor
(153,436)
Clear Image Buffer
Color 1
Color 2
Color 3
Raw video
Record Video
Record Position
Load Settings
Save Settings

Select color 1, and open saturation and intensity filters

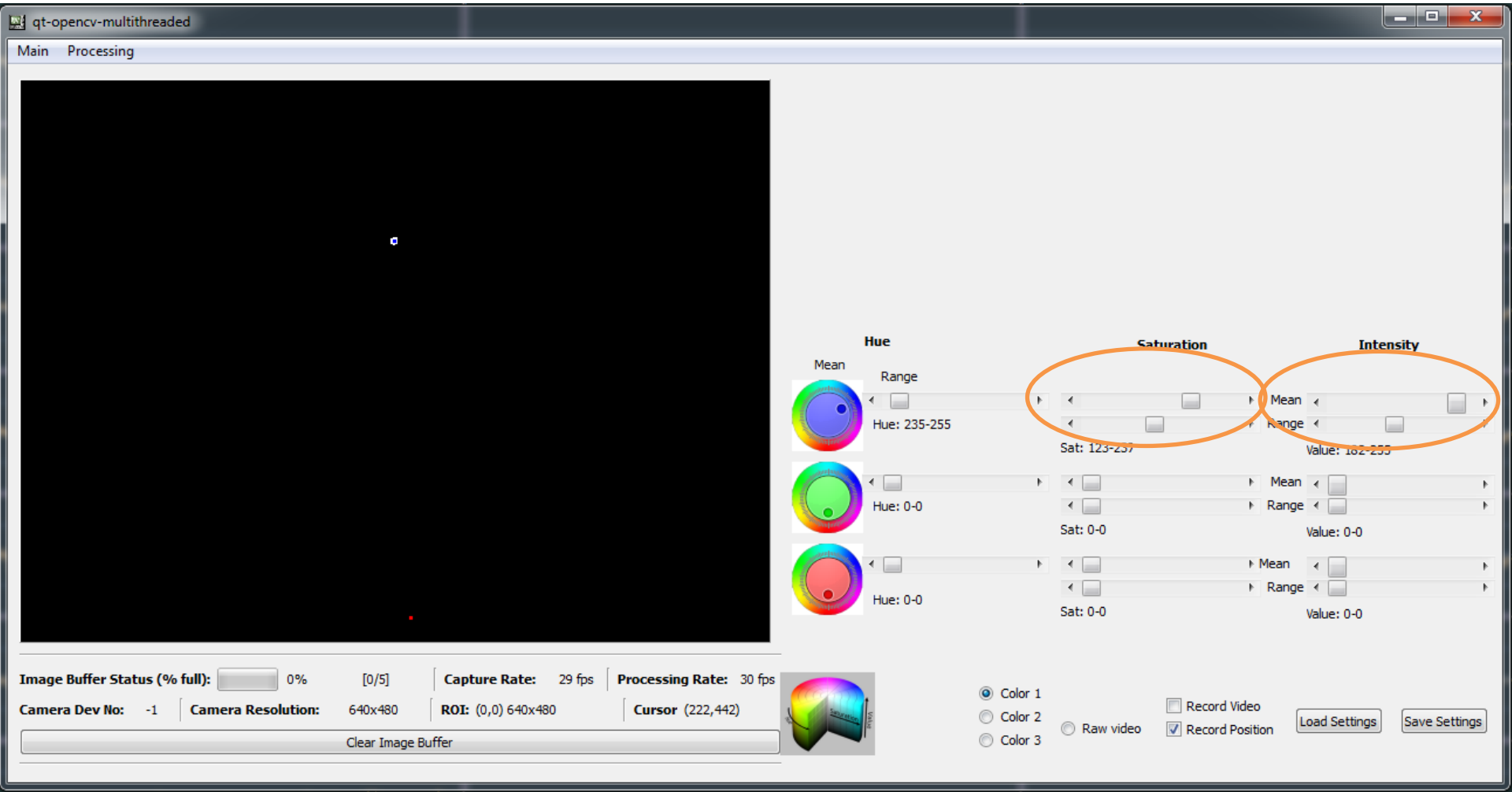


Find the desired color by setting the hue

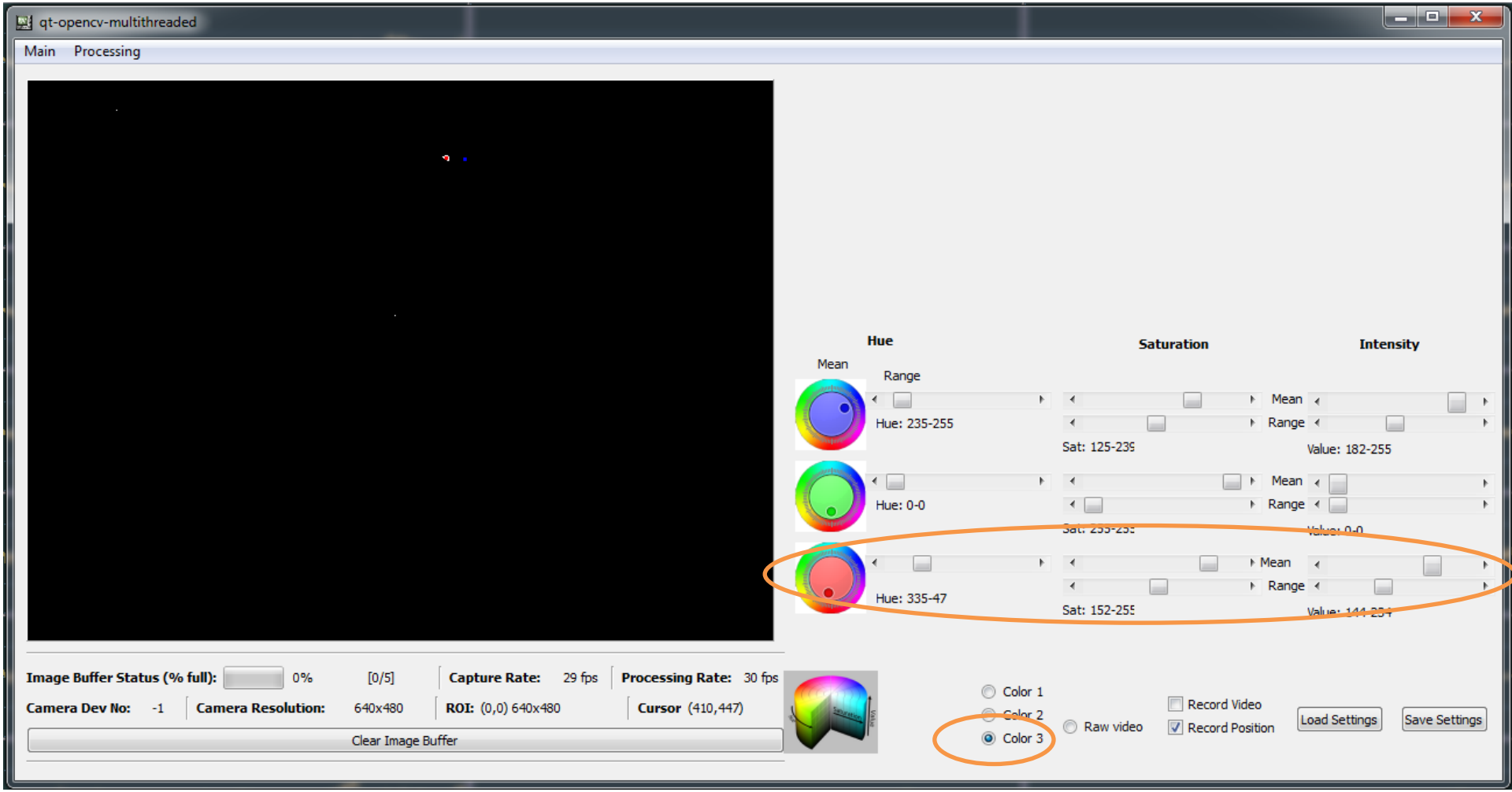


Decrease saturation and hue range to have a nice detection

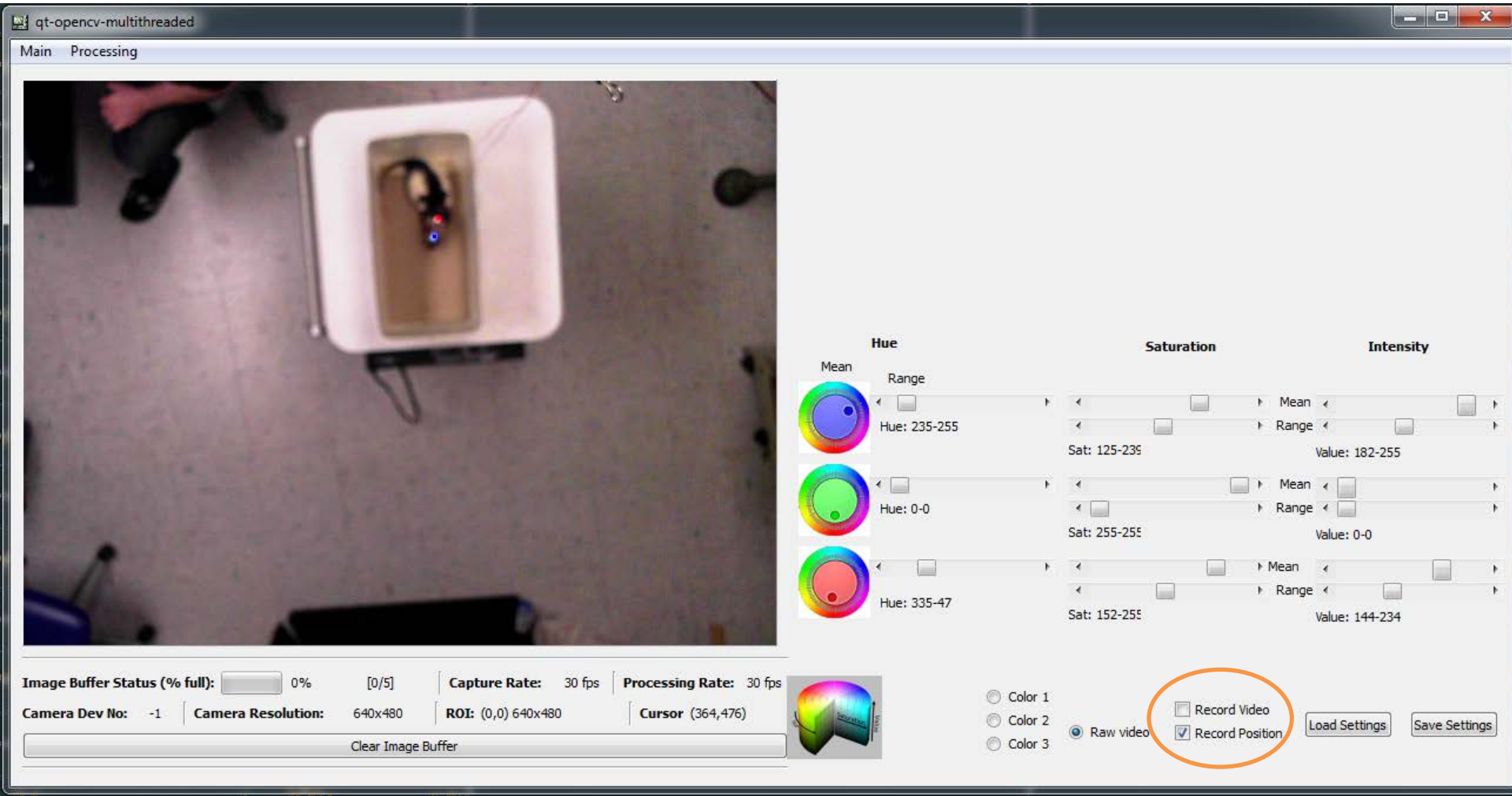
(marked by a blue dot for Color 1)



Repeat it for color 2 and 3



Animal can be tracked as a raw video also (detected LEDs are marked with dots)



Output files

- .dat – neuronal recordings
- .meta – various recording logs & infos
- .tsp – timestamps of the recorded video frames and extracted LED positions
- .mpg – recorded video file

.dat file

- 20 kSamples /channel
- Voltage range: +-5V
- Gain: 400x
- 16 bit signed integers

- DC Shift in channels! (constant within channel over time, but different across channels.

.meta file

- System = Amplipex KJE-1001
- Amplitude range max = 5
- Amplitude range min = -5
- File length (Amplipex clock (sec) = 8.4
- File size (bytes) = 86016000
- Filename = d://test.dat
- Gain = 400
- Number of recorded channels = 256
- Recording start date = Wed Dec 14 2011
- Recording start time = 22:28:51
- Sampling rate = 20000
- Sha1 code for file = 39ccbe3261dda0fc349ebedcdd9dc4b5b0fc6f7f
- TimeStamp of the end of recording (computer clock - ms) = 68737996
- TimeStamp of the start of recording (computer clock - ms) = 68729527

.tsp file

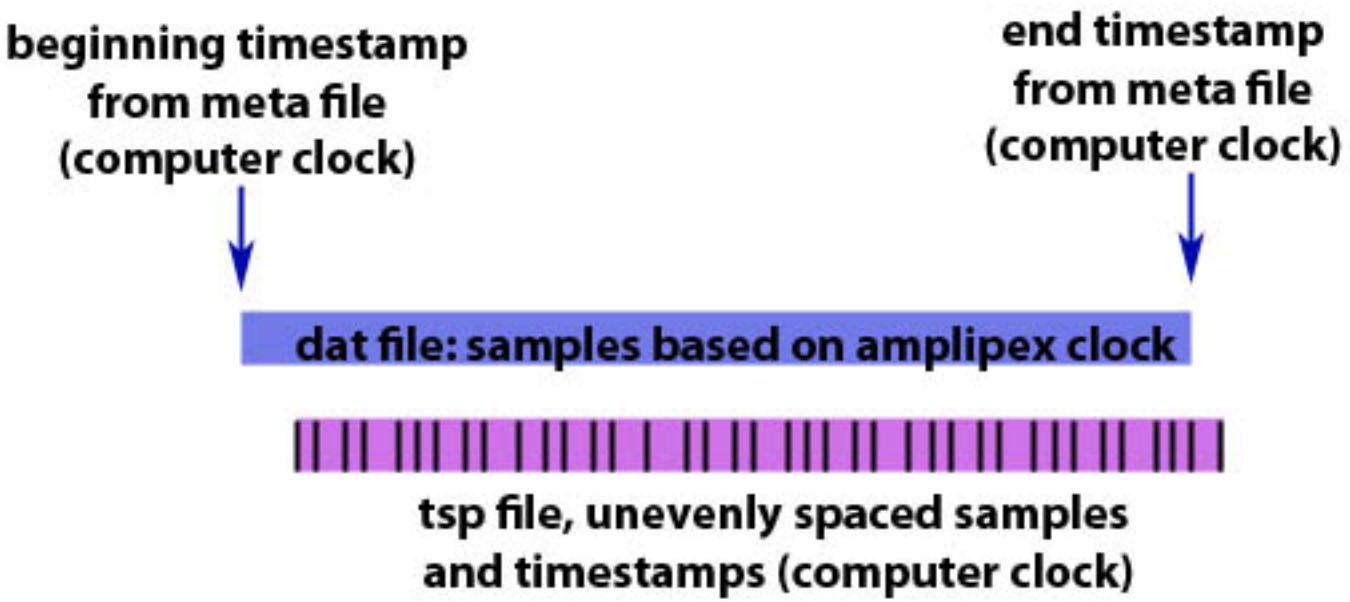
Timestamp	LED1		LED2		LED3	
	X	Y	X	Y	X	Y
68729540	367	83	-1	-1	354	93
68729568	366	82	-1	-1	354	93
68729602	367	81	-1	-1	354	93
68729631	366	81	-1	-1	354	93
68729663	366	81	-1	-1	354	93
68729695	366	81	-1	-1	354	93
68729742	367	81	-1	-1	354	93
68729775	365	81	-1	-1	354	93
68729806	367	81	-1	-1	354	93
68729839	367	81	-1	-1	354	93
68729871	367	81	-1	-1	354	93
68729906	367	81	-1	-1	354	93
68729935	367	81	-1	-1	354	93
68729964	366	81	-1	-1	354	93
68729999	367	81	-1	-1	354	93
68730033	367	81	-1	-1	354	93
68730062	366	81	-1	-1	354	93

Processing of data

- Dat file:
  - Make a backup copy of the original dat
  - Remove DC shift from channels (removeDC.m)
    - removeDC('fullfilename',channelnumber);
  - If looks nice, delete backup and go ahead with regular processing

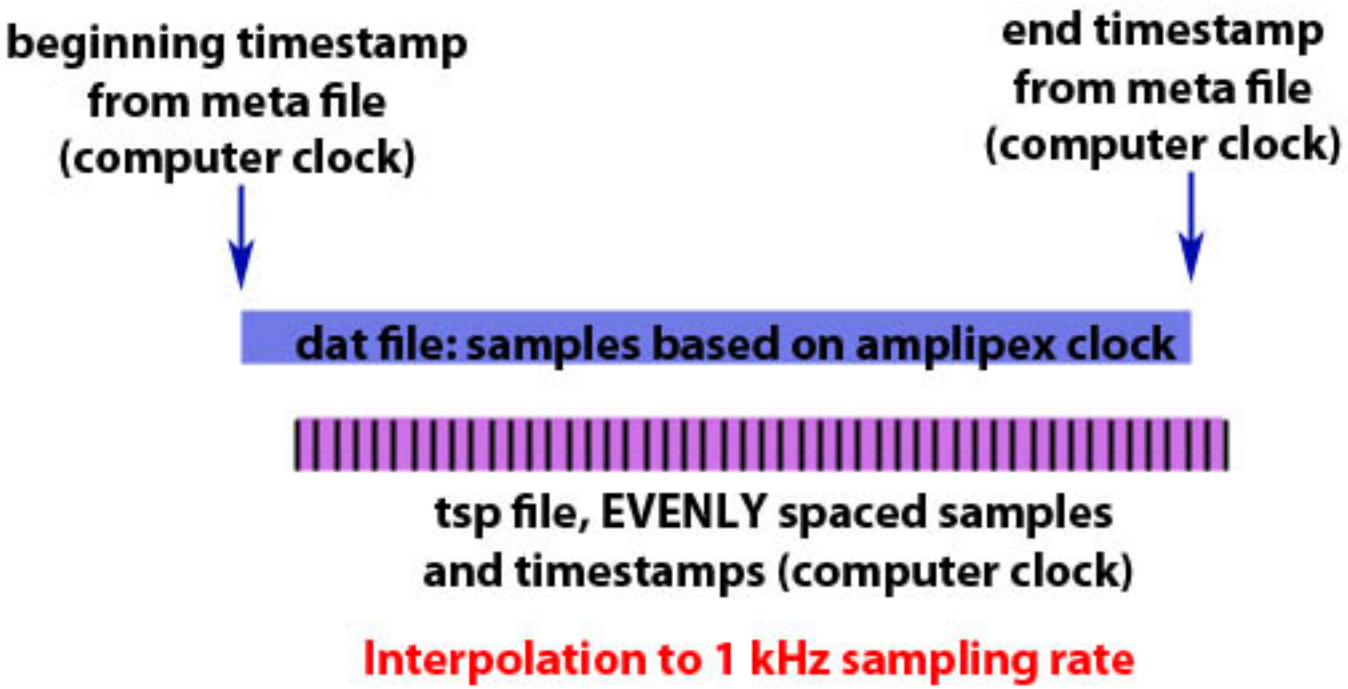
Processing of data

- Tsp file
  - aligntsp('filebase'); %Makes .whl and .whl1k files



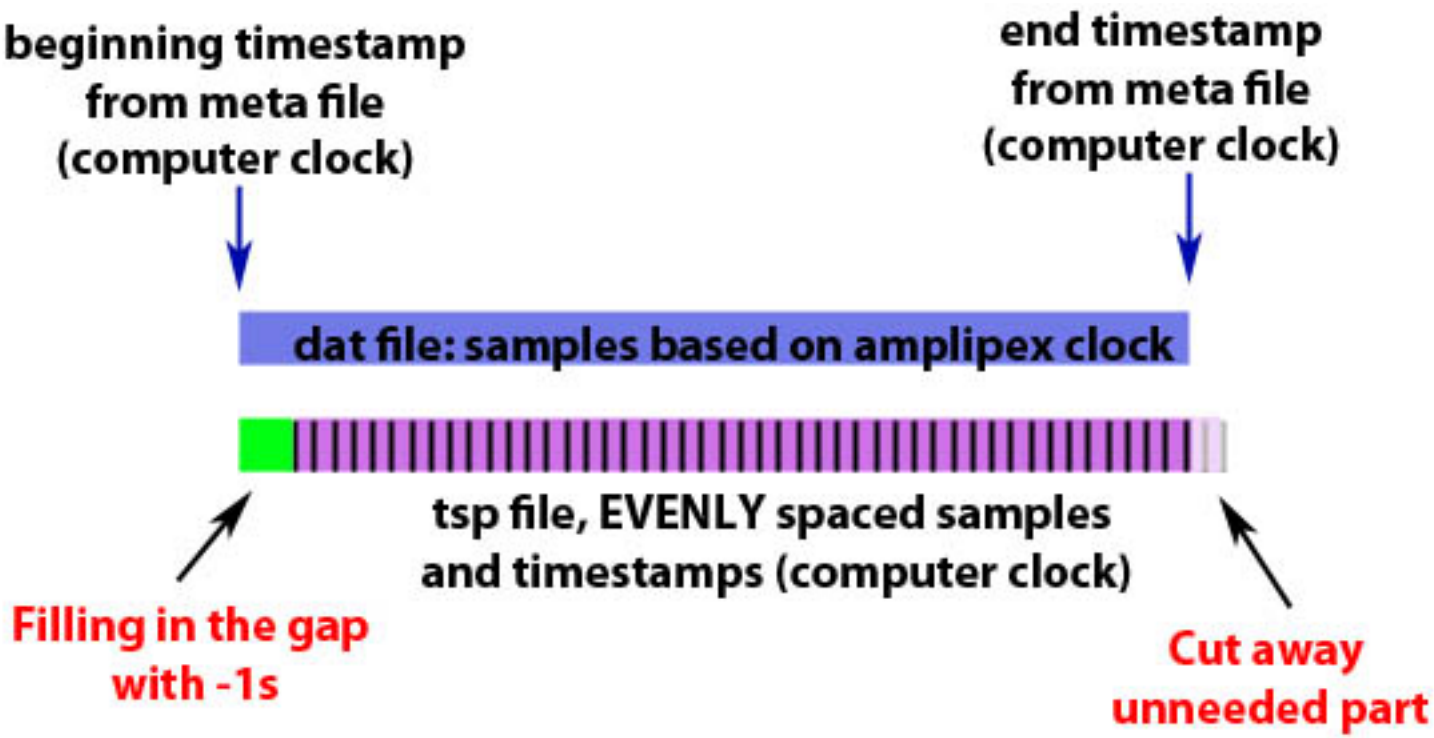
Processing of data

- Tsp file
  - aligntsp('filebase'); %Makes .whl and .whl1k files



Processing of data

- Tsp file
  - aligntsp('filebase'); %Makes .whl and .whl1k files



Processing of data

- Tsp file
  - aligntsp('filebase'); %Makes .whl and .whl1k files